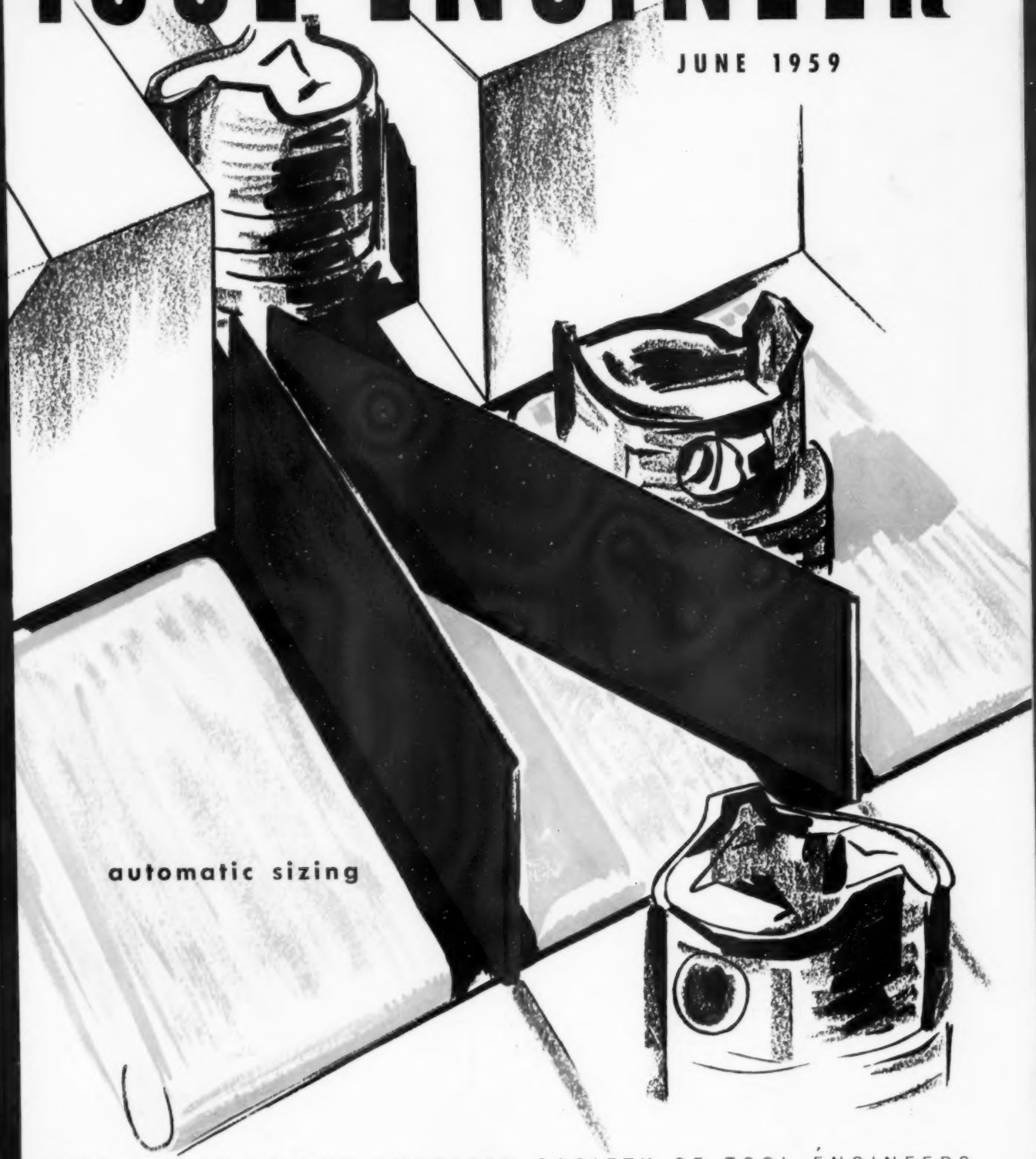
the

TOOL ENGINEER

JUNE 1959

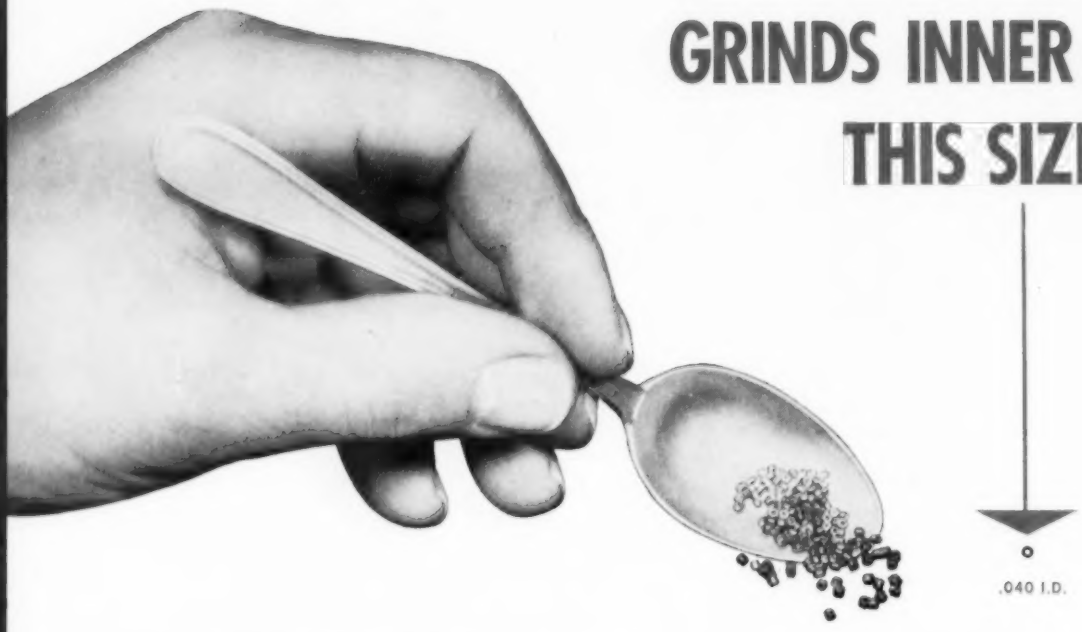


automatic sizing

PUBLICATION OF THE AMERICAN SOCIETY OF TOOL ENGINEERS

Award-winning Model 090 Centri-Matic

GRINDS INNER RACES THIS SIZE



NEW HEALD DEVELOPMENT awarded Certificate of Excellence in 1958 MINIATURIZATION AWARD for unique, systems-engineered design

THIS AWARD, the first ever made to a machine tool manufacturer, cited the Model 090 for the following contributions to miniaturization.

"The Heald Model 090 Centerless Internal Grinding Machine is considered to be a radically new development, system-engineered specifically for improved production of miniature ball bearings. Whereas previous equipment had been modified to adapt it to miniature work, the Model 090 was completely designed for this purpose alone, with all components working at optimum efficiency. With this machine, inner races as small as .040" I.D. can be ground to .00015" size tolerance and 5 microinch finish in a fully automated 15-second cycle. Major advances in design include shoe-type centerless workholding with rotation from both front and rear faces — specially-designed superspeed wheelheads — hydrostatic anti-friction feeding cross slide with ultra-sensitive electronic control — and sensitized method for automatically maintaining precise wheel-to-diamond relationship and compensating for drift."

Whether you grind miniature parts or not, this development is a significant example of Heald's ability to solve tough precision-finishing problems. Your Heald engineer will welcome *your* problems, too.

HEALD

It PAYS to come to Heald

THE HEALD MACHINE COMPANY

Subsidiary of The Cincinnati Milling Machine Co.
Worcester 6, Massachusetts

Chicago • Cleveland • Dayton • Detroit • Indianapolis • New York

the tool engineer

Vol. 42, No. 6 June 1959

Measuring Error: Detection and Correction ..... *By William J. Hill* 73

Statistical methods make it possible to determine the reliability of measurements and to get desired results at lowest cost.

Gadgets 79

Adjustable support for rough castings . . . combination tool for lathe work . . . automatic bending die . . . method for centering tailstocks.

How to Weld Tool Steels ..... *By John J. Chyle* 83

Successful welding of tool materials depends on selecting the best process for the material and type of workpiece to be welded.

Fatigue Properties of High-Strength Steels 92

Retained austenite, in amounts up to 10 percent, lowers fatigue strength. Refrigeration before tempering improves strength.

Compound Angles: Nomogram Simplifies Solution ..... *By C. W. Peters* 93

Time-consuming trignometric methods for solving compound angle problems can be avoided by using graphical methods.

Bending Small-Radius Tubing Ells ..... *By Don Juleen* 101

With modern equipment, it is possible to bend 90-deg ells in stainless-steel tubing at mass production rates.

Precision Weighing with Platform Scales ..... *By E. T. Gay* 103

Standard scales can be modified to obtain accuracies within one-third ounce when weighing 2000-lb masses. The modification is simple.

Steel-Rule Dies for Low-Cost Stampings ..... *By Robert W. Reinhardt* 111

These dies can be fabricated in one day, at one-tenth the cost of conventional all-metal dies. They give excellent service.

Fabricating Investment-Cast Cobalt-Base Alloys (Reference Sheet) 117

Wear-resistant alloys can be efficiently machined. Feeds, speeds and tools for various compositions are given.

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THIS MONTH'S COVER

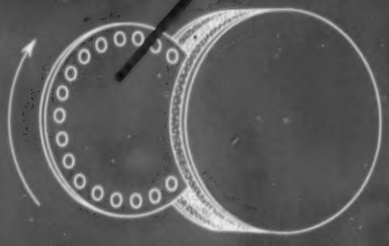
Automatic measurement and sorting operations are symbolized by this piston inspection machine at Ford's Sheffield, Ala., plant. Pistons are sorted into three categories and are automatically shunted onto the appropriate conveyor. Problems involved in precision measurement are covered in an article starting on page 73.

THE TOOL ENGINEER is regularly indexed in the *Engineering Index Service* and *Applied Science & Technology Index.*

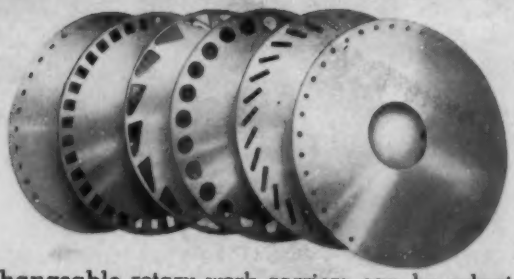
Interchangeable work carriers add profitable versatility to Gardner Disc Grinder

...rotary work carriers handle wide variety of parts in grinding two parallel surfaces in one operation

Gardner 2H30 precision double spindle grinder with rotary work carrier



Rotary work carrier is a high production means of grinding two parallel sides in one operation. Loading and unloading can be manual or automatic.



Interchangeable rotary work carriers can be adapted for workpieces of many shapes.

Typical parts: ..... washers, rings, bearing rollers, bearing races, gears; metal, ceramic, plastic, etc.
Production: ..... 600 to 2100 parts per hour
Stock removal: ..... .008" to .010"
Flatness: ..... .0001"-.0003"
Parallelism: ..... .0001"-.0004"
Uniformity: ..... .0015"-.002"

GARDNER

precision disc grinders

BELOIT, WISCONSIN

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Tooling for Space

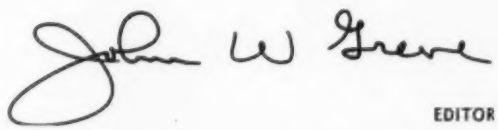
Success in reaching outer space will be due in no small measure to the contributions made by individual members of the American Society of Tool Engineers. Such a prediction could understandably be made by an enthusiastic member of the Society. Instead it is a statement made by Col. John Taylor, Assistant Chief of the Aircraft Laboratory at Wright-Patterson Air Force Base, at the annual Society meeting in Milwaukee.

His belief is based upon the need for precision and dependability in the manufacture and fabrication of a space ship. One tiny mistake which remains uncaught by inspection could spell disaster in traveling to a distant planet. The reliability which is necessary makes demands upon industry to a degree unheard of in the past. Col. Taylor emphasizes that the miracles of modern engineering are due as much to the tool engineer as to any other group in our economy.

He must be depended upon to invent new and better ways of improving fundamental standards and tolerances in industry, of simplifying and improving construction and maintainability of space ships and, in fact, of understanding and meeting the tremendous challenge of the space environment.

The relationship between ideas and achievement in construction are in many ways similar to those faced by da Vinci when production methods were unable to give birth to his designs. The difference, however, is that now there is no time to wait for production know-how to leisurely develop. Instead, it must be ready for the challenge as information and designs become available. Also, there is little chance for second guessing.

To meet the challenge which involves our own survival, Col. Taylor proposes that a Space Committee provide the Society and its members with leadership and guidance to meet the space needs from the tool industry.



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give your customers
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HIGH PRODUCTION
they
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Taper Shank

Does your drill line measure up?
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ELMIRA, N.Y.

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The Only MASTER COLLET With No Work Pressure on the Screw.

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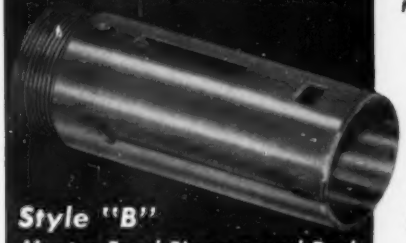
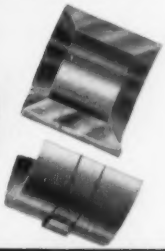
Master Collets and Pads

Pads Interchangeable Among Different Makes of Automatics





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Master Feed Fingers and Pads

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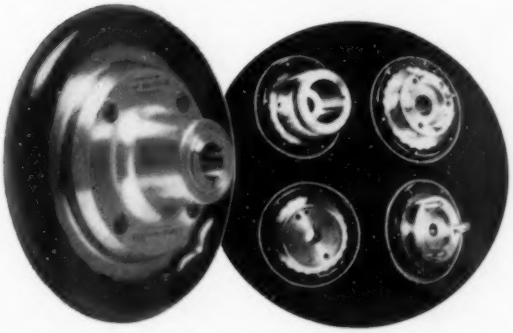
Increase Production Capacity



Available in 1 1/16"; 1 3/8"; 2 1/4"; and 3 1/2" collet capacity. Threaded nose, cam lock, tapered key-drive and American Standard spindles. *Write for Bulletin 8A.*

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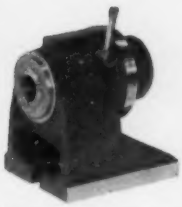
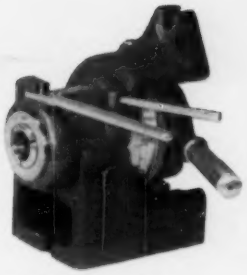


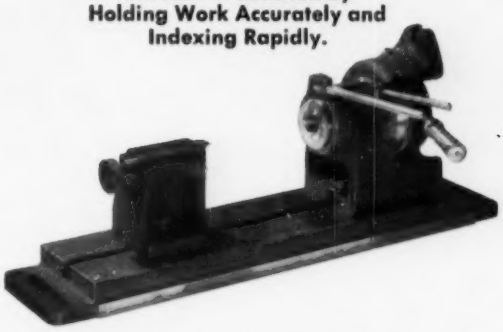
H-4 Tool Room-Inspection



HV-4 Production

HARDINGE COLLET INDEX FIXTURES

Increase Production by Holding Work Accurately and Indexing Rapidly.



HARDINGE BROTHERS, INC., Elmira, N. Y.
Write for Bulletin CF5

HARDINGE
ELMIRA, N.Y.

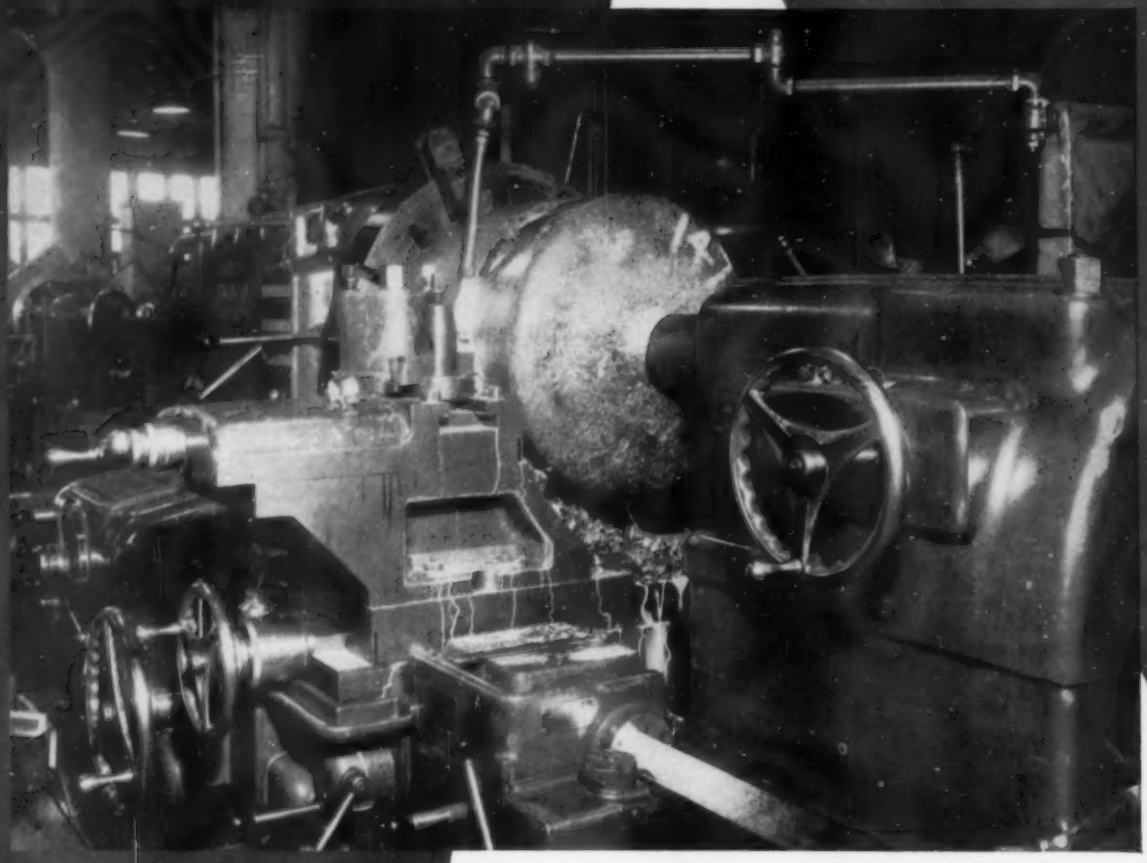
COLLETS for LATHES and MILLERS

ACCURACY — DURABILITY — LOW COST

Write for Bulletin 56 — Complete collet ordering information for all Lathes, Millers, Grinders and Fixtures

HARDINGE BROTHERS, INC., Elmira, N. Y.

Immediate stock delivery from Atlanta, Boston, Chicago, Dayton, Detroit, Elmira, Hartford, Los Angeles, Minneapolis, New York, Oakland, Philadelphia, San Francisco, St. Louis.



"AMERICAN"

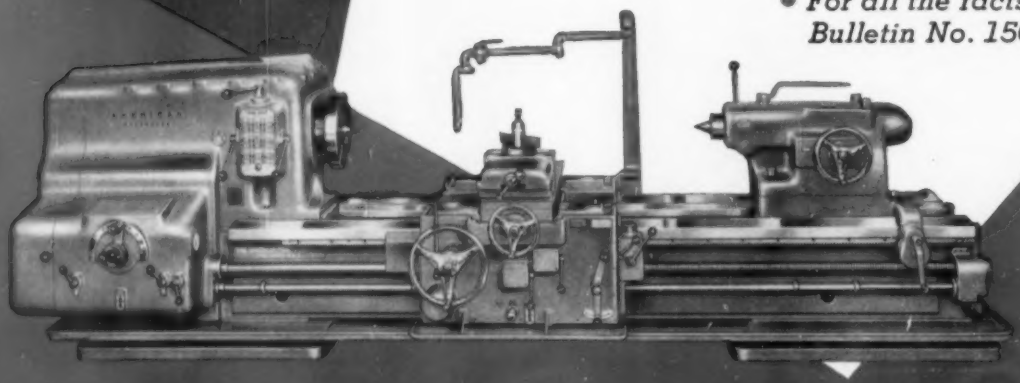
"Scalping" a $12,000 TITANIUM Ingot...

The operation shown by the accompanying illustration is "scalping" (cutting) the hide off of an ingot of pure titanium sponge. The ingot is 25" in diameter and the skin or hide that must be turned off is from ½" to 1" thick.

Due to the terrific cutting resistance of this "hide" low cutting speeds and exceptional ruggedness and rigidity are essential to satisfactory tool life.

Because power, rigidity, ruggedness and inherent stamina are outstanding characteristics of "American" Pacemaker Lathes they have been selected for this severe service by all of the major titanium fabricators.

• *For all the facts ask for Bulletin No. 150.*



THE AMERICAN TOOL WORKS CO. Cincinnati 2, Ohio, U. S. A.

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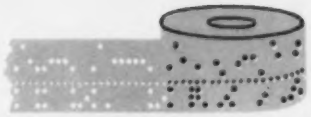
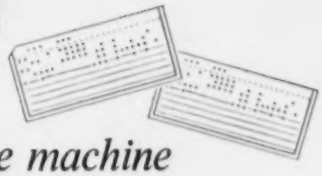
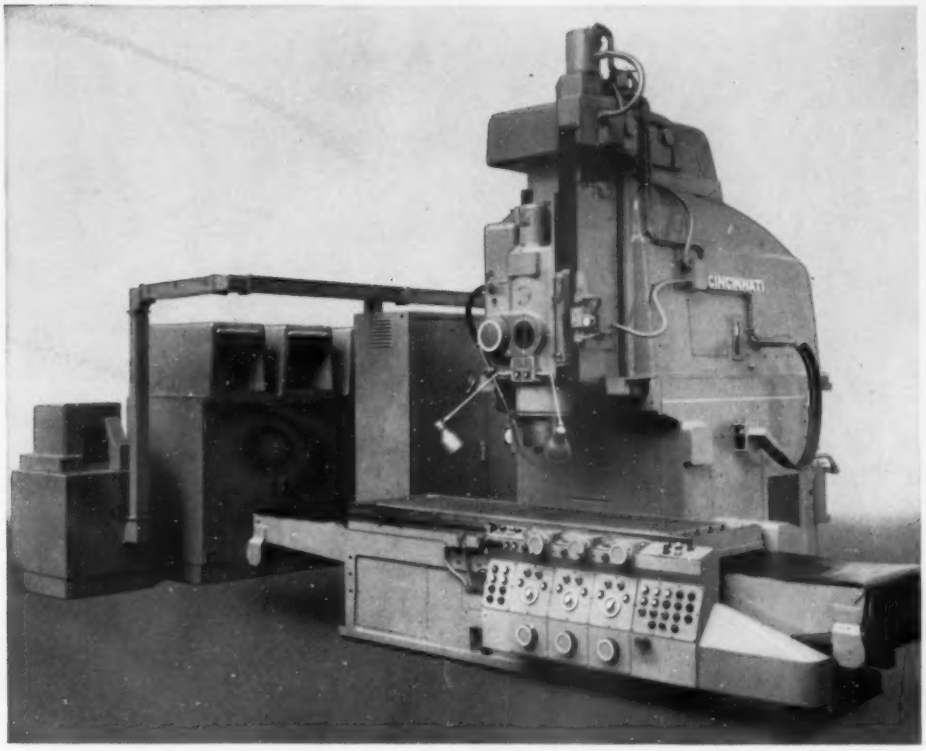
LATHES AND RADIAL DRILLS





CINCINNATI NUMERICAL CONTROL

gives you positive **COST CONTROL** *at the machine*



CINCINNATI *30" Vertical Hydro-Tel Milling Machine, 60" table traverse, equipped with CNC. Two cabinets at far left house numerical control equipment.*

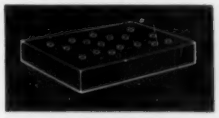
No more "cut and try" for machining operations. No change in setup for rough and finish cuts, new and reground cutters, right- and left-hand parts. No operator fatigue near the end of the shift. These are some of the ways in which Cincinnati Numerically Controlled (CNC) Machine Tools give you positive cost control.

Other CNC advantages: **Single Responsibility**. . . coordinated, cooperative effort by Cincinnati specialists in numerical control and in every activity required to deliver completely integrated machines. **Simple Programming** . . . CNC requires fewer input data points. **Precision Machining** . . . CNC is an absolute digital-analog system, assuring precise accuracy. **Simple to Use, Versatile.**

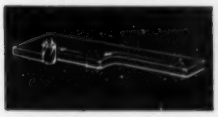
Cincinnati Numerical Control is the newest, most positive way to reduce lead time and many non-productive elements of excessive machining costs. Want specific job application data? Just present your production problems to us. For preliminary information, write for publication M-2066.

The Cincinnati Milling Machine Co., Cincinnati 9, Ohio

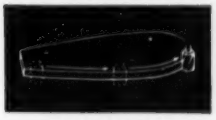
SEQUENCE CONTROL
CNC assures reliable automatic selection of feeds, speeds, spindles, coolant flow and other auxiliary machine functions.



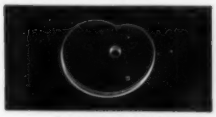
POSITIONING
Tool-work positioning is fast, accurate. CNC eliminates expensive jigs, fixtures; reduces setup time.



STRAIGHT LINE CUTS
Multiple straight line cuts to exact length, and with abrupt changes in direction, can be programmed, set up and run in a fraction of the time required using conventional methods.



CONTOURING
CNC greatly reduces lead time in reproducing complex, contoured parts; eliminates need for expensive templates, masters.



CAM MILLING
Fast, extremely accurate machining of master cams is assured on CNC controlled machines. CNC system of parabolic interpolation greatly simplifies programming of contour.

CINCINNATI

BUILDERS OF FINE MACHINE TOOLS: MILLING • GRINDING • BROACHING • DIE SINKING • CUTTER AND TOOL GRINDING • PRODUCTION LINES • METAL FORMING, HARDENING MACHINES

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THIS IS AN **ACE** DRILL BUSHING

the one that outwears and outperforms!

IT'S GRATIFYING TO KNOW YOU MAKE THE BEST!

The man who makes Ace Drill Bushings is no Johnny-come-lately. He's not a novice. His bushings last a long, long time. That makes them cost you less.

He cares about quality. Some say it doesn't pay to build stuff too good . . . just get by . . . imply that engineers don't know the difference, but they're wrong. The man who makes Ace Drill Bushings doesn't buy that line.

He makes the best. Doesn't have to offer excuses or alibis. Doesn't have to dodge his customers; they're his friends. He saves them lots of money. He backs every claim with controlled quality . . . His Drill Bushings are consistent — every one the same — you can depend on them.

He sleeps well at night, too — every night — year after year. His customers are happy. He doesn't worry about competition — just goes right on making the very best drill bushings — rolling up bigger and bigger sales.

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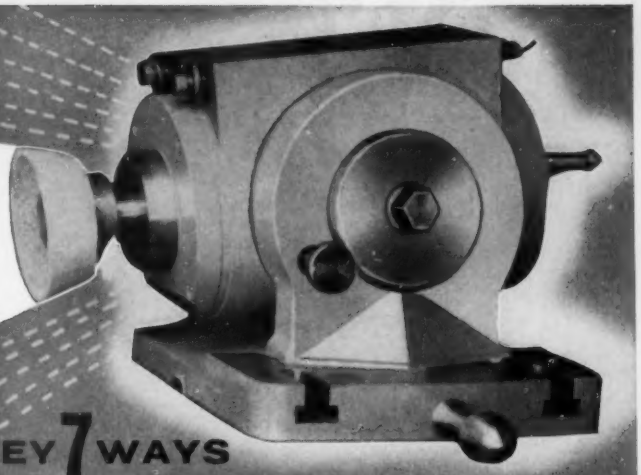
HERE'S AN

ANGLE

AND A NEW APPROACH



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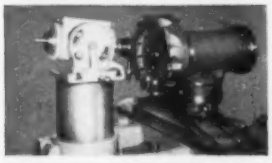
ON ALL YOUR TOOL AND CUTTER GRINDING

Specify this

POPE SUPER PRECISION, 1 HP, 3600 RPM MOTORIZED TOOL AND CUTTER GRINDER CLEARANCE ANGLE SWIVELLING HEAD WITH ANGULAR ADJUSTMENT IN A VERTICAL PLANE



and get these seven savings:

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3. A single set-up grinds most cutters and reamers all over, using the swivelling table and Pope tilting head.
4. No more mistakes on clearance angles. They read directly in degrees from the scale provided on the head.
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No. 118

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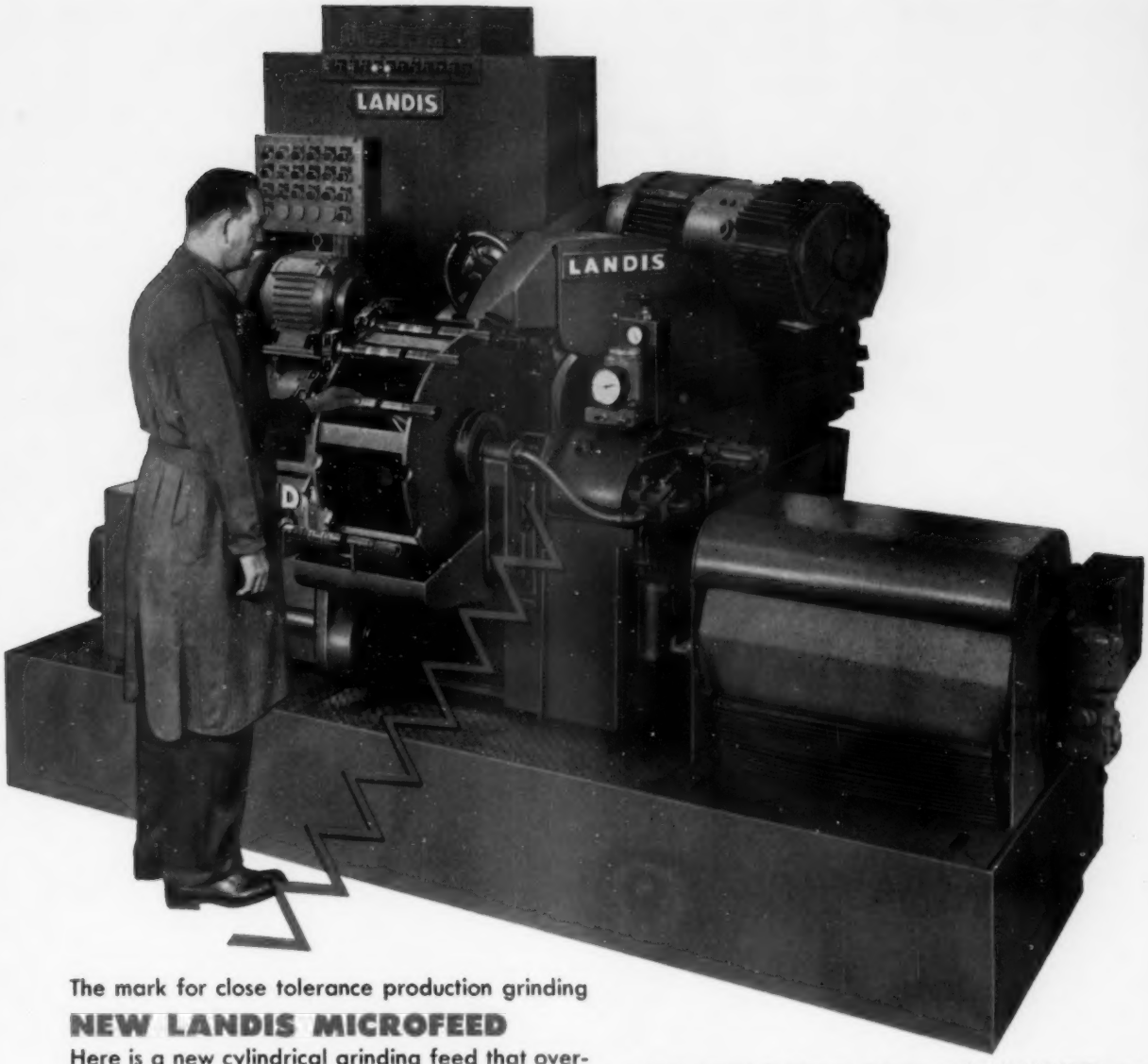
new

LANDIS microfeed

. . . a fine feed to final size that guarantees precision to "tenths" tolerances on a **production** basis



The mark for close tolerance production grinding

NEW LANDIS MICROFEED

Here is a new cylindrical grinding feed that overcomes all the limitations of conventional feed systems for this class of work.

New Landis R Plunge Grinder with MICROFEED automatically grinding 3 diameters and face of transmission shafts with dependable accuracy.

Cost saving production advantages of Landis MICROFEED

- automatically compensates for wheel wear and machine temperature variations
- eliminates manual re-adjustments of wheel feed due to wheel and machine variables
- eliminates costly rejects and reworking
- easy to set feed reduces set-up time

LANDIS

precision grinders

LANDIS TOOL COMPANY / WAYNESBORO, PENNSYLVANIA

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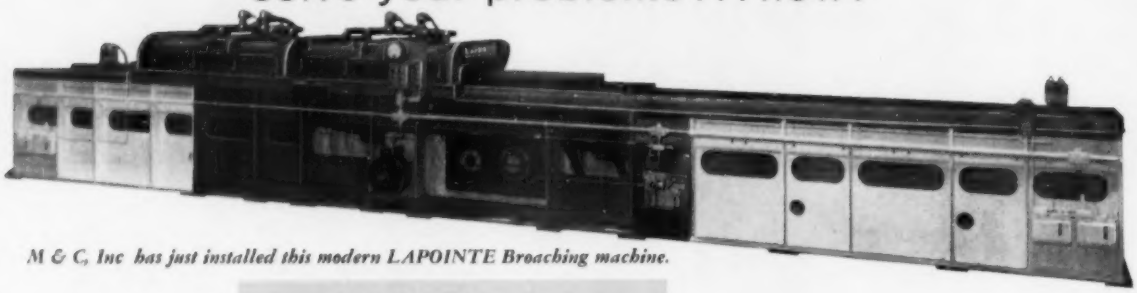
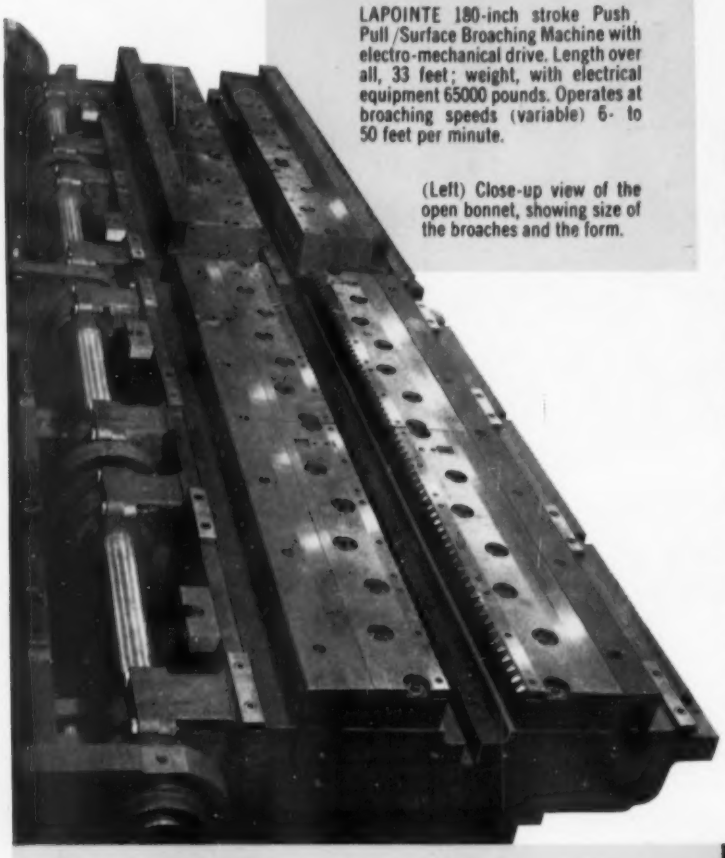
URANIUM ★ TITANIUM ★ ZIRCALLOY ★ 347 STAINLESS

Are you puzzled about BROACHING
the materials of this atomic age?

If so, let LAPOINTE —BROACHING
solve your problems . . . now!



M & C, Inc has just installed this modern LAPOINTE Broaching machine.



LAPOINTE 180-inch stroke Push Pull /Surface Broaching Machine with electro-mechanical drive. Length over all, 33 feet; weight, with electrical equipment 65000 pounds. Operates at broaching speeds (variable) 6- to 50 feet per minute.

(Left) Close-up view of the open bonnet, showing size of the broaches and the form.

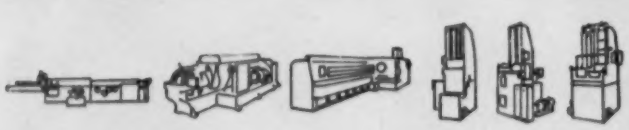
No one can equal Lapointe's experience in broaching the difficult metals used in today's jets, missiles and nuclear power plants. As far back as 1950, we were broaching test specimens of zirconium — and our research and experimentation have kept abreast of all the metals and alloys in this critical field. This Lapointe machine is broaching zircalloy, one of the latest developments of our fast-moving atomic age. Tolerances are close, the part is thin, *and five feet long!* Production is amazingly fast—about 100-to-1 against another metal-removing method that was being used.

Lapointe has been recognized as the undisputed leader in the art of broaching, with nearly sixty years of engineering experience to draw on, *exclusively in broaching*. All of this valuable background is available to you. A request will bring a Lapointe Field Engineer to your plant, promptly.

THE LAPOINTE MACHINE TOOL COMPANY

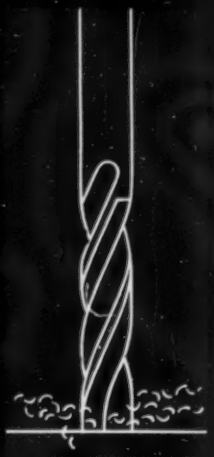
HUDSON, MASSACHUSETTS • U.S.A. *In England: Watford, Hertfordshire*

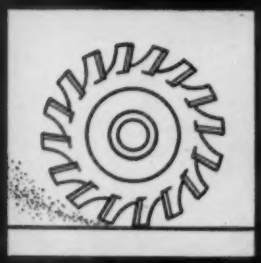
THE WORLD'S OLDEST AND LARGEST MANUFACTURERS OF BROACHING MACHINES AND BROACHES



LAPOINTE
known to be the best in
BROACHING

USE READER SERVICE CARD; INDICATE A-6-13



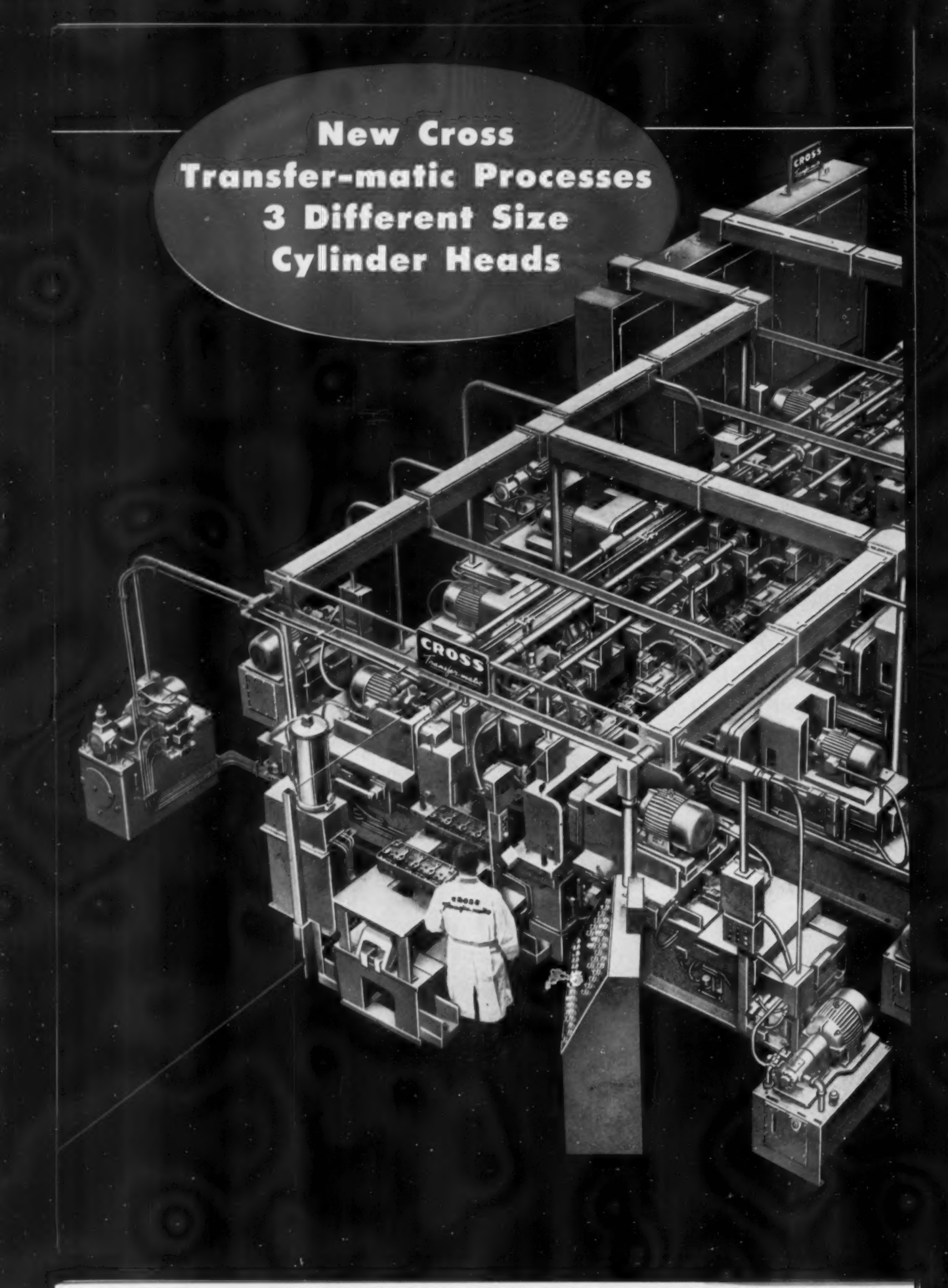


vega

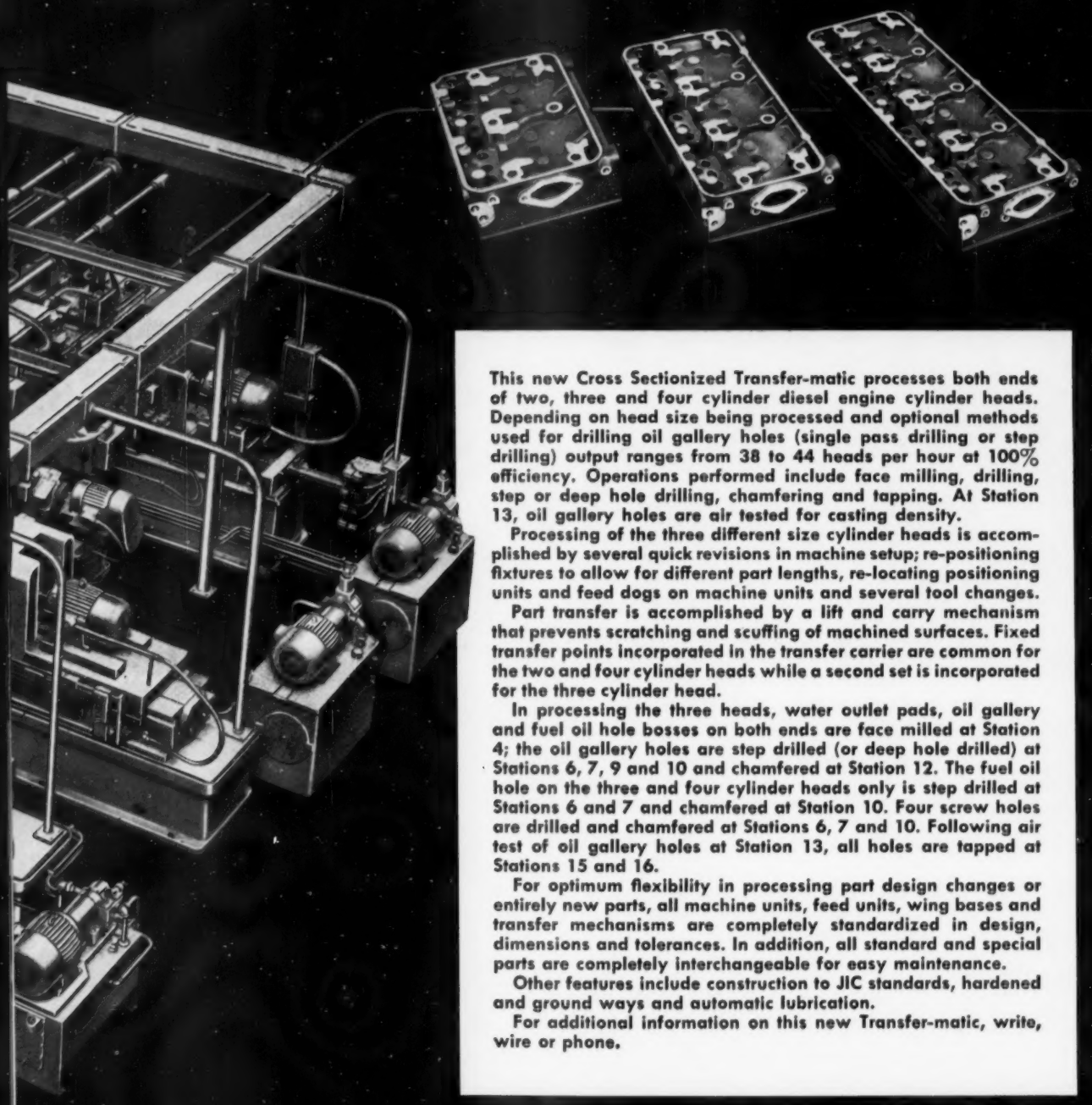
air-hardening tool and die steel is the easiest to machine of all air-hardening tool steels. Vega was specially developed by Carpenter to combine toughness and the machining properties of an oil-hardening steel with the safety in hardening of an air-hardening grade. It is safe to harden and even intricate dies with many cutouts, sharp corners and thin sections come through heat treatment with outstanding freedom from distortion and size change. Call your local Carpenter Service-Center for immediate delivery from complete stocks.

the *Carpenter* Steel Company, Reading, Pa.

New Cross Transfer-matic Processes 3 Different Size Cylinder Heads



Another Automation First by Cross



This new Cross Sectionized Transfer-matic processes both ends of two, three and four cylinder diesel engine cylinder heads. Depending on head size being processed and optional methods used for drilling oil gallery holes (single pass drilling or step drilling) output ranges from 38 to 44 heads per hour at 100% efficiency. Operations performed include face milling, drilling, step or deep hole drilling, chamfering and tapping. At Station 13, oil gallery holes are air tested for casting density.

Processing of the three different size cylinder heads is accomplished by several quick revisions in machine setup; re-positioning fixtures to allow for different part lengths, re-locating positioning units and feed dogs on machine units and several tool changes.

Part transfer is accomplished by a lift and carry mechanism that prevents scratching and scuffing of machined surfaces. Fixed transfer points incorporated in the transfer carrier are common for the two and four cylinder heads while a second set is incorporated for the three cylinder head.

In processing the three heads, water outlet pads, oil gallery and fuel oil hole bosses on both ends are face milled at Station 4; the oil gallery holes are step drilled (or deep hole drilled) at Stations 6, 7, 9 and 10 and chamfered at Station 12. The fuel oil hole on the three and four cylinder heads only is step drilled at Stations 6 and 7 and chamfered at Station 10. Four screw holes are drilled and chamfered at Stations 6, 7 and 10. Following air test of oil gallery holes at Station 13, all holes are tapped at Stations 15 and 16.

For optimum flexibility in processing part design changes or entirely new parts, all machine units, feed units, wing bases and transfer mechanisms are completely standardized in design, dimensions and tolerances. In addition, all standard and special parts are completely interchangeable for easy maintenance.

Other features include construction to JIC standards, hardened and ground ways and automatic lubrication.

For additional information on this new Transfer-matic, write, wire or phone.

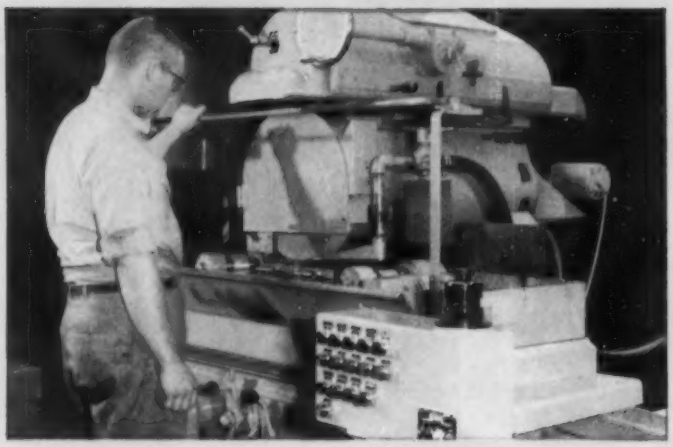
Established 1898

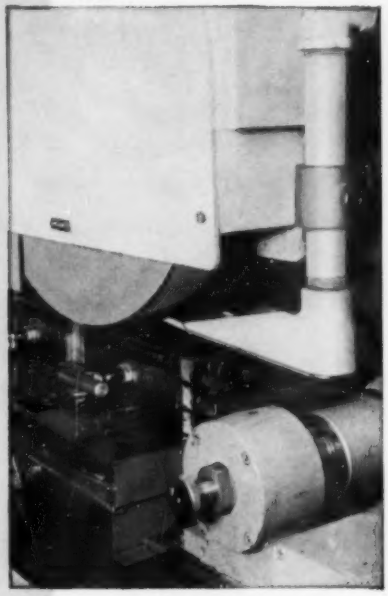
THE CROSS CO.

First in Automation

PARK GROVE STATION • DETROIT 5, MICHIGAN

Thompson — TRUFORMING CUTS COSTS 66%
. . . DOUBLES PRODUCTION AND IMPROVES PRODUCT AT THE OLIVER CORPORATION





In the production of ledger plates, used in the cutter bar of mowing machines, The Oliver Corp. of Chicago, formerly first milled the teeth, then hardened the plate. The hardening process caused distortion and variance in uniformity which impaired the cutting action of the bar.

On the advice of Thompson engineers, a Type BB Truforming Grinder with a 2½" width grinding wheel was installed to process these ledger plates as a finished grinding operation. The plates are now heat treated first and the teeth are then formed by grinding.

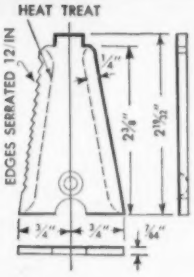
The installation of the Thompson Truforming Grinder has accomplished the following results:

1. **Cut total production costs from $3.18 to $1.06 per 100 pieces.**
2. **Increased the production rate from 1600 to over 3600 pieces per 8-hour shift.**
3. **Provided constant uniformity in the workpieces.**
4. **Eliminated the full-time service of one man.***
5. **A pair of $160.00 milling cutters formerly produced 20,000 pieces. A $60.00 grinding wheel now produces well over 40,000 pieces.**

The leadership of Thompson Truforming Grinders results from 25 years of research and development work in crush form grinding. Today these machines are opening up hundreds of practical, time-saving, profit-improving and cost-cutting applications for industry.

Thompson's engineering experience is available to you without obligation. Write for Catalog T558.

**Automatic machine cycle allows operator time to countersink hole in plate—an operation formerly requiring one man's full time.*



LEDGER PLATE
High Carbon Manganese Steel
Rockwell C52-58

"Keep Thompson in mind for that daily grind"

THE THOMPSON GRINDER CO.
SPRINGFIELD, OHIO

Thompson SURFACE GRINDERS

USE READER SERVICE CARD; INDICATE A-6-15 USE READER SERVICE CARD; INDICATE A-6-16

precision promised ..precision delivered!

That's the story of American Drill Jig Bushings

When precision is expected, **you can depend on American!** American distributors offer a complete line of standard, off-the-shelf precision drill jig bushings **in your city.**

Let us send you our new catalog with drill bushing selection tables — making it easy for you to specify the proper bushings, for all your bushing needs.

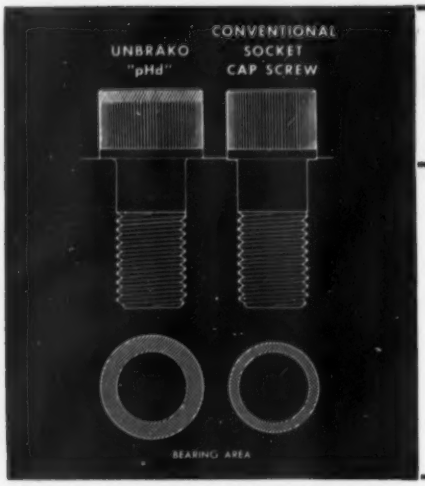
American **DRILL BUSHING CO.**

5107 PACIFIC BOULEVARD • LOS ANGELES 58, CALIFORNIA

TRADE MARK ®

SPS RELIABILITY / *A dynamic standard of predictable performance*

Larger head diameter of UNBRAKO pHd* socket cap screws increases load-carrying capacity up to 233%



COMPARISON OF UNBRAKO pHd AND CONVENTIONAL DESIGN

Each size can now be utilized with equal reliability. The bearing stress is consistent from size to size in the new UNBRAKO pHd socket cap screws.

SCREW SIZE	HEAD DIAMETER (in.)		BEARING AREA (sq. in.)		LOAD TO INDENT IN CAST IRON (lb.)		% INCREASE USABLE STRENGTH	TIGHTENING TORQUE (lb.-in.)‡	
	Old	pHd	Old	pHd	Old	pHd		Old	pHd
¼	.375	.375	.041	.041	3,280	3,280	—	165	180
5/16	.438	.468	.047	.072	3,760	5,760	54	325	360
3/8	.562	.562	.102	.102	8,150	8,150	—	600	660
7/16	.625	.656	.116	.148	9,270	11,800	27	1,000	1,040
½	.750	.750	.188	.188	15,000	15,000	—	1,450	1,590
5/8	.875	.937	.203	.305	16,200	24,400	51	2,900	3,190
¾	1.000	1.125	.223	.432	17,800	34,600	94	5,050	5,600
7/8	1.125	1.312	.254	.594	20,300	47,500	134	8,000	8,900
1	1.312	1.500	.364	.785	29,100	62,800	116	10,550	13,600

*Proper Head Design—a factor in higher product reliability.

‡Normal recommended seating torques for unplated screws, fine threads.

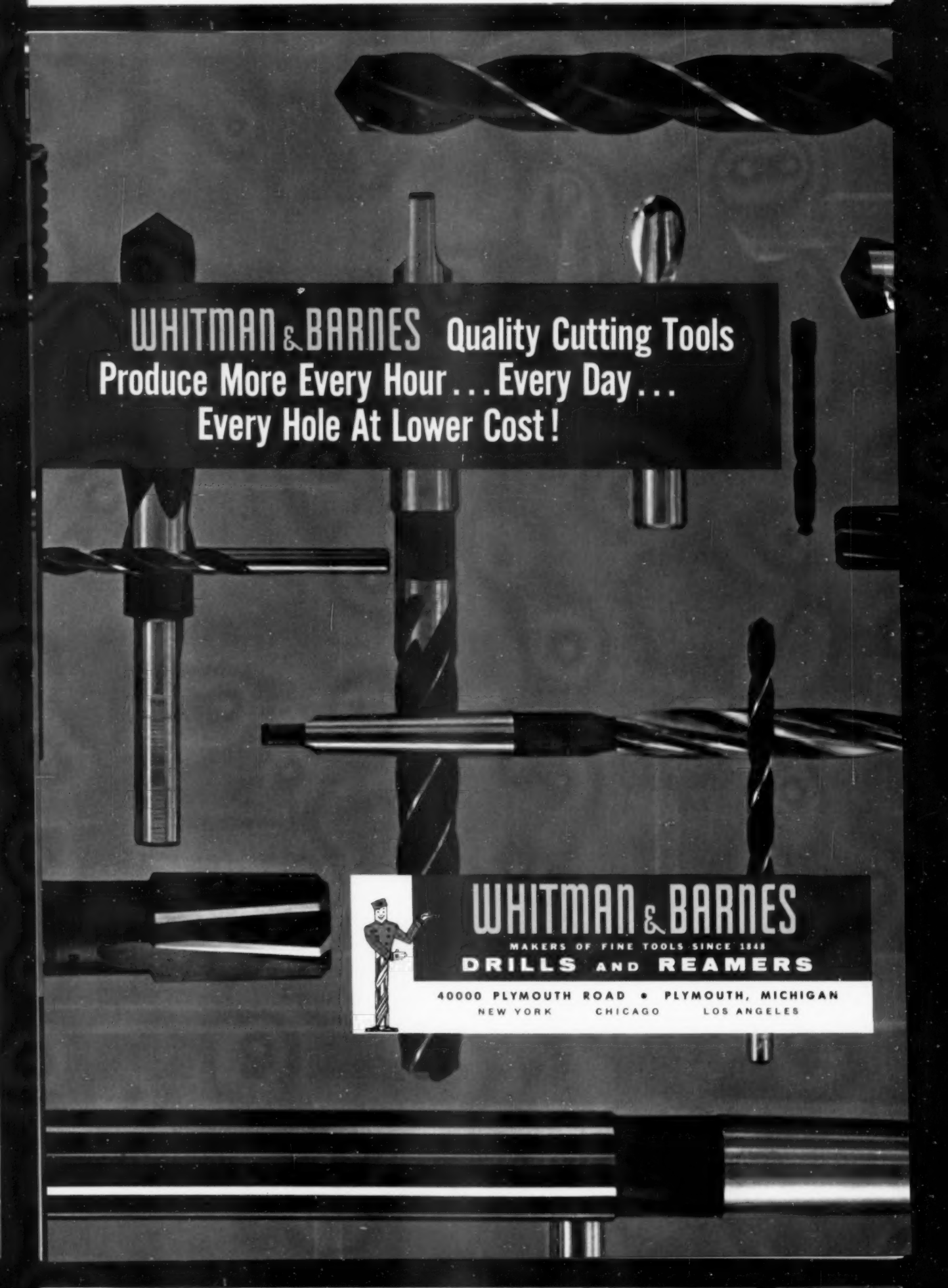
For you, pHd means sounder fastening, with resultant increases in product reliability at no increase in price. With pHd UNBRAKO socket cap screws you get stronger, more reliable joints; space and weight saving through use of smaller or fewer fasteners; greater fatigue resistance through application of consistently higher preloads; fewer fasteners working loose under vibration or shock; and elimination of washers under cap screw heads in many applications.

The principal reasons for the superior performance of broad-bearing pHd UNBRAKO socket cap screws are up to 233% more load-carrying capacity than with a conventional cap screw and the ability to be tightened tighter. Because of increased bearing area, the vital preload that keeps screws tight and prevents fatigue failures is distributed over more of the bolted material. Indentation under high working load is eliminated. And pHd UNBRAKO screws have been designed for high tightening. In many cases the socket has been enlarged for better key engagement. Combined with this feature is the fact that all the tightening force is used to preload the screw, in contrast with the conventional cap screw—where indentation saps some or all of the tightening force.

See your authorized SPS industrial distributor for complete details. Or write SPS—manufacturer of precision threaded industrial fasteners and allied products in many metals, including titanium. Unbrako Socket Screw Division, STANDARD PRESSED STEEL CO., Jenkintown 37, Pa.

SPS **Jenkintown • Pennsylvania**

Standard Pressed Steel Co. • The Cleveland Cap Screw Co. • Columbia Steel Equipment Co. • National Machine Products Co. • Nutt-Shel Co. • SPS Western • Standco Canada Ltd. • Unbrako Socket Screw Co., Ltd.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Produce More Every Hour . . . Every Day . . .
Every Hole At Lower Cost!
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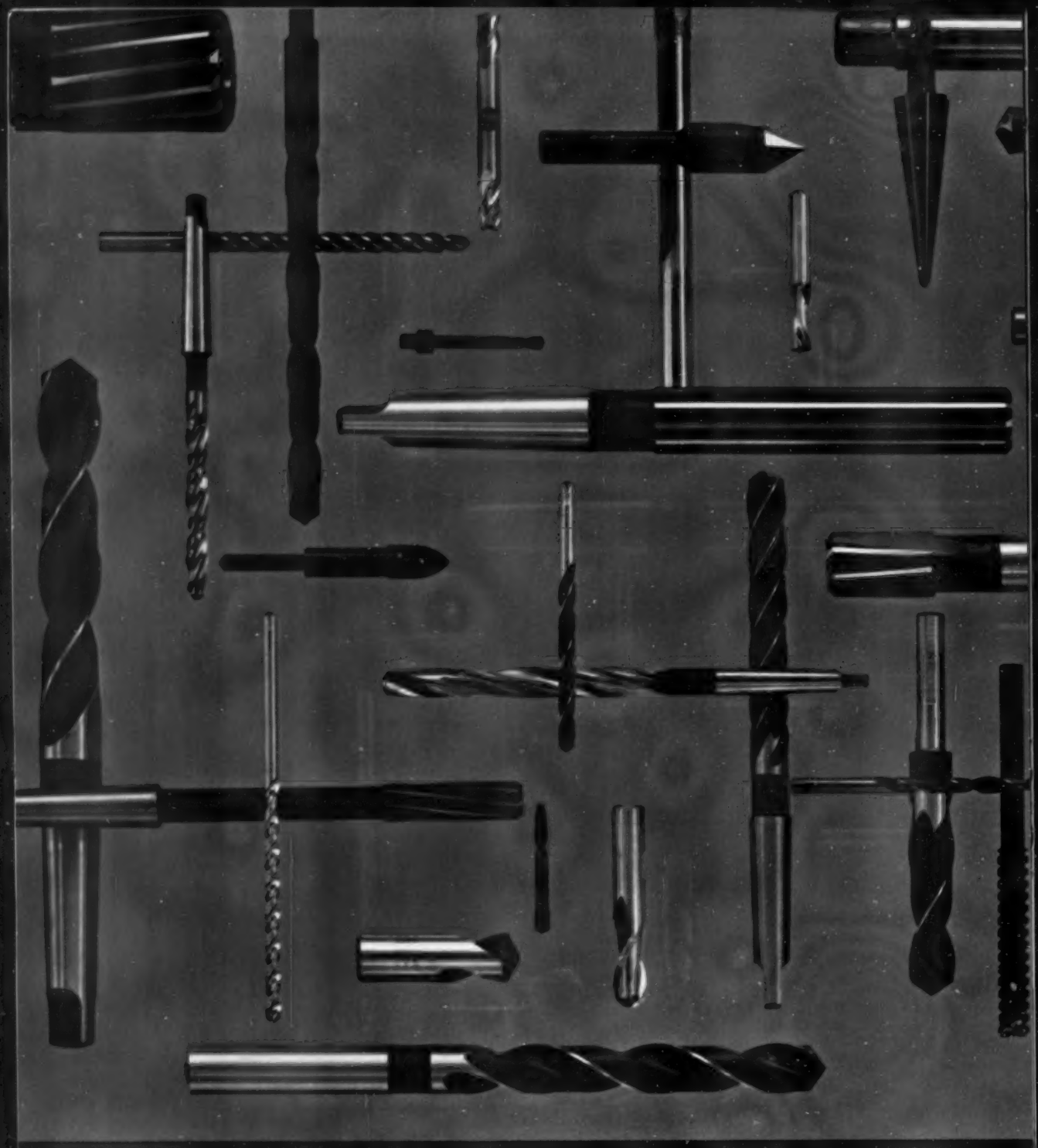
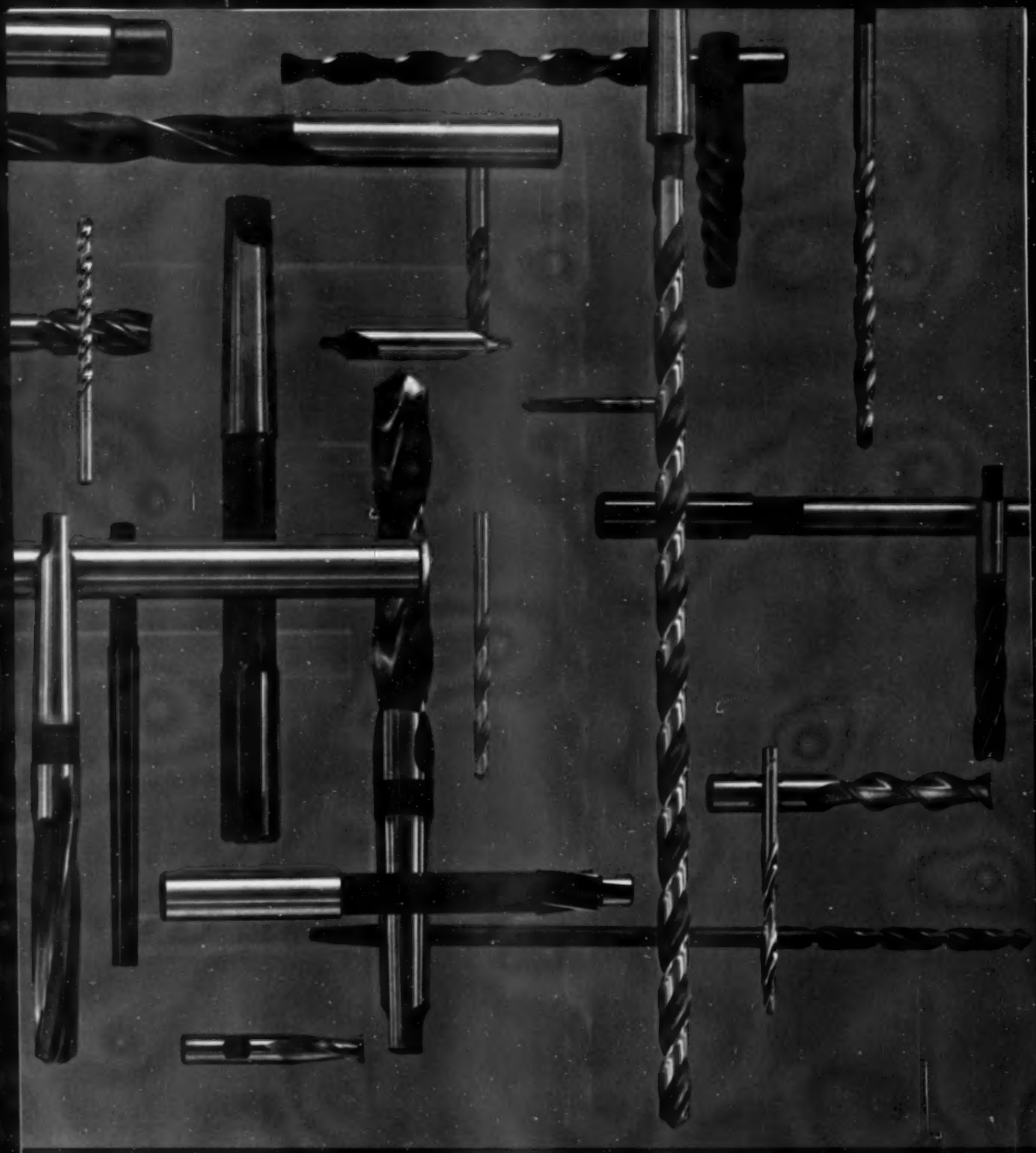
MAKERS OF FINE TOOLS SINCE 1848
DRILLS AND REAMERS
40000 PLYMOUTH ROAD • PLYMOUTH, MICHIGAN
NEW YORK CHICAGO LOS ANGELES



WHITMAN & BARNES Cutting Tools

Are More Than Product Lines . . . They're

Your Partners in Production Progress



In your constant fight against operating costs, the initial price of cutting tools is NOT your answer—realistic, long-range economy is! With an unequalled selection of application tested standard tools . . . with superior special tools . . . with the best in engineering and technical assistance . . . Whitman & Barnes guarantees to help you secure higher production, improved product quality AND lower production costs!

W&B

HELP ON YOUR CUTTING TOOL PROBLEMS

111 years of experience in the manufacture of fine tools enables us to offer you the best in help for your cutting tool problems. W&B trained cutting tool specialists throughout the country stand ready to assist you with the best applications of standard W&B tools or in the designing of special tools to meet your unusual problems. Just write to W&B or request this service through your W&B distributor. Our representative will quickly contact you.

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Actual companies . . . actual applications . . . actual problems. All are detailed in this free brochure. It provides on-the-production-line facts and figures as to how and why Whitman & Barnes cutting tools can effectively cut costs in a wide variety of applications and materials. Just fill in the coupon below for your free copy.

SECURE IMMEDIATE, EFFICIENT SERVICE

Your local W&B Distributor stocks most standard types and sizes of W&B tools. He can give you fast delivery and the best in service. Give him a call today.

SEND FOR YOUR NEW W&B CATALOG

The new Whitman & Barnes Catalog No. 108 is yours for the asking. Its 132 pages contain the latest standards and specifications together with complete technical information.

Just write to Whitman & Barnes on your company letterhead and we will be happy to send you a copy.

WHITMAN & BARNES

MAKERS OF FINE TOOLS SINCE 1848

DRILLS AND REAMERS

40000 PLYMOUTH ROAD • PLYMOUTH, MICHIGAN

NEW YORK CHICAGO LOS ANGELES

Whitman & Barnes
Plymouth, Michigan

☐ Please send me your free Case History Brochure.

☐ Please have a W&B representative call to discuss cutting tool problems. No obligation, of course.

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COMPANY_____

ADDRESS_____

CITY_____ STATE_____

U.S. Press Room Equipment and F.P.P. full profit potential

U. S. Press Room Equipment is designed for "F.P.P." — to help make press operations more profitable for you . . . to give to each press maximum flexibility and efficiency.

In many cases, press room productivity depends upon the flexibility of your equipment. The wider the range of material your presses can handle, the more productive and profitable they can be. When you combine this wider range of production with increased efficiency, you are approaching a production standard ideal for press rooms.

It is this standard — which has as its aim the realization of Full Press Room Profit for you — that dictates the manufacture and performance of every piece of U. S. Press Room Equipment.

For example, U. S. Slide Feeds are precision built units for the accurate feeding of coil stock into punch presses. They are adaptable to the feeding of one or more separate strips of wire or flat stock, either of regular or **irregular cross section.**

U. S. Flat Stock Straighteners and Two-Way Wire Straighteners are perfect complements to U. S. Slide Feeds. When teamed together they guarantee accuracy and contribute to prolonged die life.

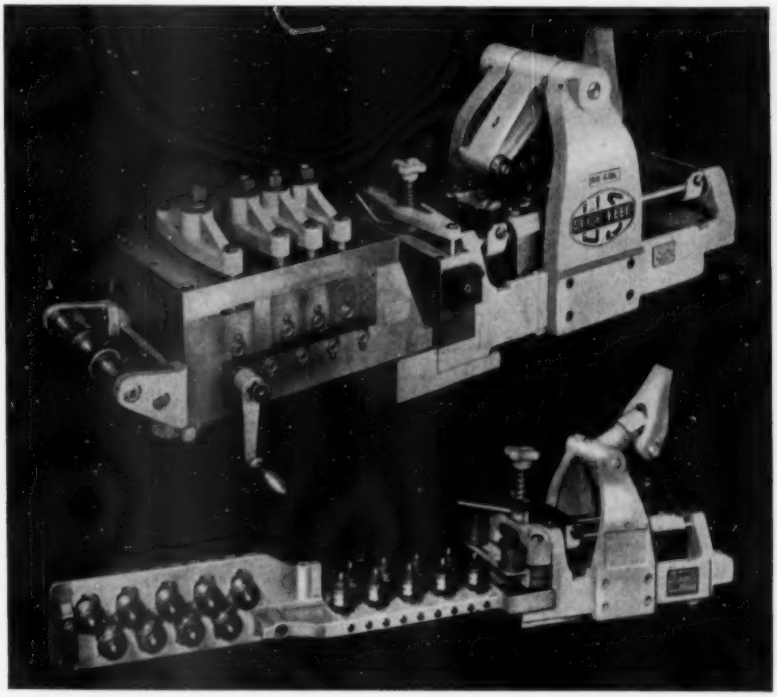
Write today for U. S. Bulletin No. 85T and learn how you can obtain maximum flexibility and efficiency for your present Press Room equipment — to give you your "F.P.P."

Some typical stock cross-sections readily accommodated by U. S. Slide Feeds.

Below: SF-1 U. S. Slide Feed with SS-07 Plain Stock Straightener on conventional OBI press.

Main Illustration Top: SF-68A U. S. Slide Feed with SS-27 Plain Stock Straightener. Max. width capacity 6" feed length adjustable up to 8".

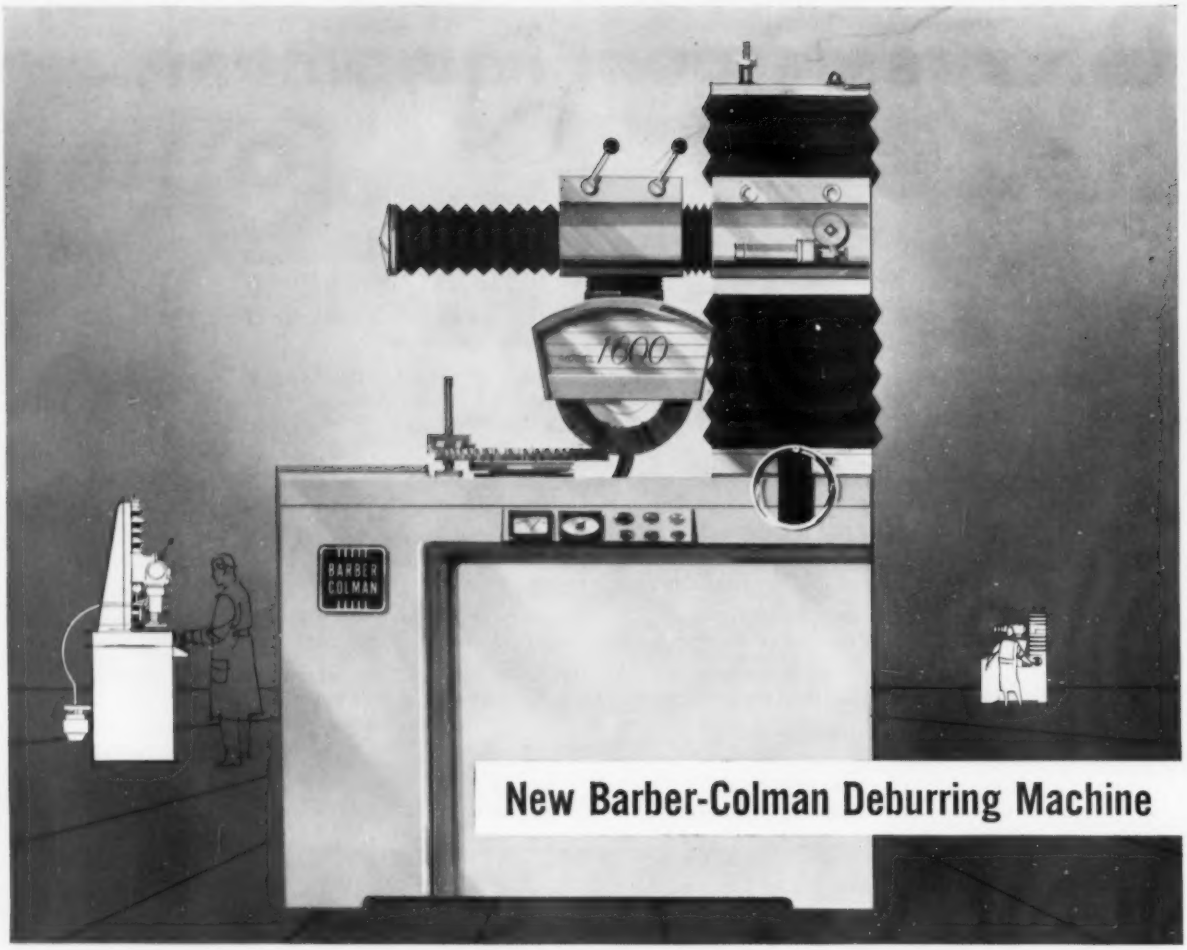
Lower: SF-O U. S. Slide Feed with Two-Way Wire Straightener (nine rolls in each plane).



U. S. TOOL COMPANY, INC.

AMPERE *(EAST ORANGE)* NEW JERSEY

U. S. Multi-Slides® • U. S. Multi-Millers® • U. S. Automatic Press Room Equipment • U. S. Die Sets and Accessories



Fast, Efficient Gear Deburring

Deburring of spur and helical gears and sprockets is now fast, easy, and accurately controlled using a 3M "PG" wheel on the Barber-Colman Deburring Machine. This new method, developed by 3M Company and Barber-Colman Company, does not leave a burr on either the tooth profiles or the face of the gear. Also, it can grind a small chamfer on the complete tooth profile when required. Gears up to 16" diameter can be deburred on the Model 1600 machine. For fine-pitch gears, a smaller machine using a 6" PG wheel will be available. The same process also can be applied to deburring of gears larger than 16" diameter.

This versatile machine is designed specifically for the deburring of gears and other toothed forms using the "PG" wheel. It is automatic cycling, and most gears can be deburred in a matter of a few seconds. The formed wheel, which is dressed easily on the machine, rotates in timed relationship with the work. After the first dressing, wheels require no further maintenance. The wheel is fed automatically into the work a predetermined amount during each cycle and is engaged with the work for a predetermined length of time. After the initial setup, the operator just loads and unloads the machine.

For further information, contact your nearest Barber-Colman representative or the factory. We will be glad to arrange a demonstration showing how this machine will deburr your parts.

Barber-Colman Company

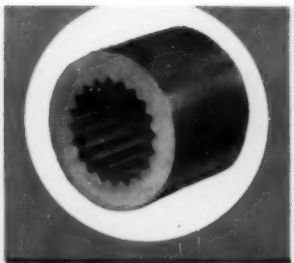
BARBER COLMAN

63 Loomis Street, Rockford, Illinois

USE READER SERVICE CARD; INDICATE A-6-24

Another Meta-Dynamics Division development in

"Chipless machining"!



Ratchet
Material—AISI C-1020
Operation—Form I.D.
Production—300/hr.

Heat exchanger tubing
Material—Copper
Operation — Form fins
Production — 16″ of tubing formed per minute.

NEW CINCINNATI

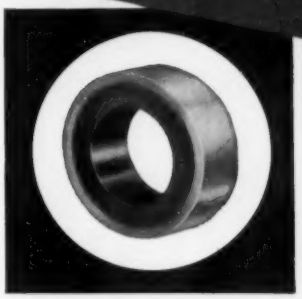
Intraform

Rapidly produces complex internal profiles to close tolerances, with low cost tooling.

This new *chipless machining* method makes possible low cost production of parts having intricate I.D. profiles that would be difficult or time consuming to machine by conventional methods.

Hollow cylindrical stock, ferrous or non-ferrous, with open or blind holes, is placed over a mandrel and "kneaded" by rapidly pulsating, rotating dies. The smooth, continuous kneading action redistributes the metal to reproduce the profile of the mandrel in the I.D. of the part. The work is formed to close tolerances and with fine surface finish. Tensile strength and hardness of the metal are also improved.

Work diameters ranging from ⅛″ to 5″ can be cold formed on standard Cincinnati Intraform machines, which can also be used for bonding laminated tubing and for reducing and tapering solid or tubular stock. For a description of the process and its many advantages, write for Bulletin M-2060, or call in a Meta-Dynamics Division field engineer.



Laminated tubing
Material — Aluminum and copper
Operation—Bond copper lining to aluminum tube
Production — 24″ of tubing bonded per minute.

Left photo shows workpiece prior to Intraform operation. Note mandrel in front of part. Right photo shows workpiece after Intraform operation with profile of the mandrel reproduced in I.D. As workpiece feeds and mandrel does not, only a short, relatively inexpensive mandrel is required. Time for this operation was 16 seconds.

Intraform
META-DYNAMICS DIVISION
Machines for Metal Forming and Heat Treating

THE CINCINNATI MILLING MACHINE CO.
Cincinnati 9, Ohio, U.S.A.

CINCINNATI

is this the one best cutter for low cost MILLING?

We happen to know it is—on this specific job!

But frequently operators will rely on "pet cutters" for milling a variety of parts and materials. Result: Either higher costs or inferior finish . . . and usually both.

The problem has always been to match the cutter *exactly* to work and machine on every job.

Solutions to problems like these are our main product. And only after a penetrating study of machine, work, depth of cut, speed, feed rates and finish requirements do we recommend any cutter.

The inserted blade cutter pictured above is an example. On the work and the machine for which it was designed it is "the one *best* cutter for low cost milling."

We would welcome the opportunity to tell you more about this unique cutter selection service. Write:

This helpful new booklet tells you how to reduce the cost of chips and improve your milling and boring performance. Ask for a free copy of booklet No.68.

THE
INGERSOLL
MILLING MACHINE COMPANY
CUTTER DIVISION
68F FULTON AVENUE • ROCKFORD, ILLINOIS

USE READER SERVICE CARD; INDICATE A-6-26

Want to cut costs on parts like these?

Here's how tracing will help you save

The simple, basic setup shown above handles nearly 300 different parts for a well-known manufacturer of drive line components. All work is performed on one Gisholt MASTERLINE No. 4 Ram Type Turret Lathe with a JETracer on the rear of the cross slide. Standard tools on the hex and square turrets are used to face, chamfer and reduce the stock while the JETracer finishes all diameters, steps, blends and radii. The 6⅜"-long, 2"-diameter stepped shaft (above at left) is typical and is completed in two operations with total f.t.f. time only 4.95 minutes.

Here are just a few things the JETracer can do for you:

- **Shorten setup and change-over time**
- **Simplify machining and eliminate operator errors**
- **Save cost of form tools, multiple tool blocks and holders**
- **Reduce inspection time (only one length and one diameter need checking)**
- **Minimize or eliminate secondary operations (through finer finish, greater accuracy)**
- **Increase production through automatic machining of complex surfaces**
- **Free operator to handle extra units or perform other work**

Gisholt has developed a complete line of JETracers for use with ram and saddle type turret lathes, automatic turret lathes and single-spindle chucking lathes. These include rear cross slide, turret and independent slide mounted units, single or multi-pass types. *All are designed to operate at full capacity of the machines to which they are applied, without limiting machine functions or restricting the use of standard tools.*

You'll want to see for yourself how the JETracer adds flexibility, speeds operations and cuts costs on standard and problem parts. Send the coupon today for your free copy of the new JETracer catalog, or call your Gisholt Representative for complete information.

GISHOLT MACHINE COMPANY

Madison 10, Wisconsin

ASK YOUR GISHOLT REPRESENTATIVE ABOUT FACTORY-REBUILT MACHINES WITH NEW-MACHINE GUARANTEE

Gisholt Machine Company
1227 E. Washington Ave.
Madison 10, Wisconsin

Please send a copy of the new Gisholt JETracer catalog.

Name ..... *Title* .....

Company .....

Street address .....

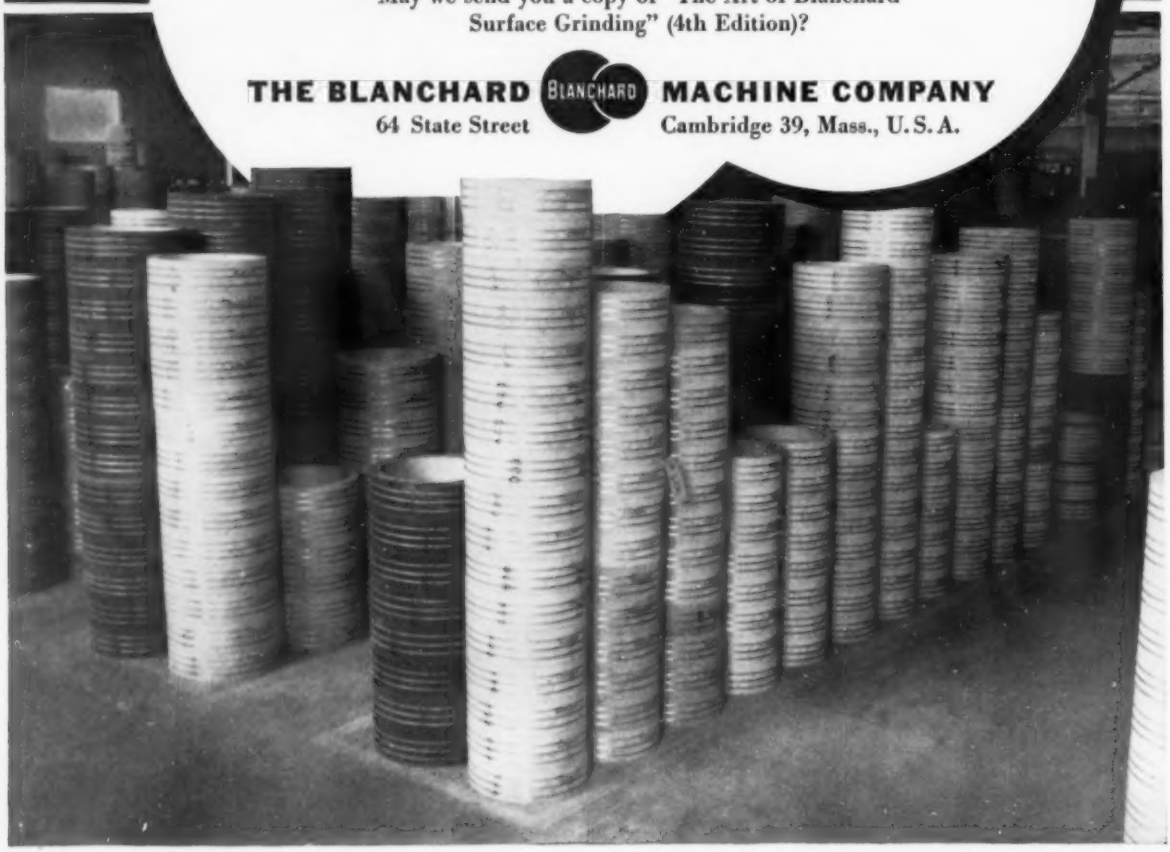
City ..... *Zone* ..... *State* .....

When you "Put it on the Blanchard"
. . . be sure to use Blanchard Wheels

Your Blanchard Surface Grinder is designed to give you peak production and economy on hundreds of different grinding jobs. But, for every job you run, *there's one particular wheel that does it best!* That's why Blanchard manufactures and stocks a wide variety of silicate, resinoid and vitrified bonded wheels and segments.

Your Blanchard representative will be glad to help you select the wheel—or wheels—best suited to *your* grinding operations. Call or write him today. May we send you a copy of "The Art of Blanchard Surface Grinding" (4th Edition)?

THE BLANCHARD MACHINE COMPANY
64 State Street — Cambridge 39, Mass., U.S.A.



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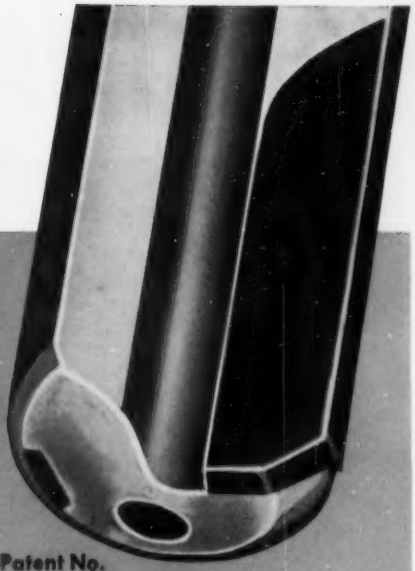

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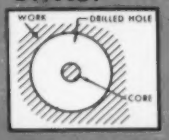
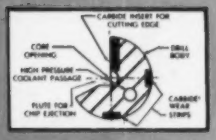




Superior Techniques

. . . Using STANDARD'S TARGET Gun Drill it is now possible to drill deep or shallow holes with extreme accuracy . . alignment . . and high surface finish.

STANDARD'S Superior Technical Skills DEVELOPED IT! Utilizing the core principle, thrust requirements were reduced, minimizing tendency of drill to run.

Detachable design feature of carbide heads (9/16th or larger): allows easy replacement when necessary. Less machine down time.

Contact your Authorized Distributor for full details on this example of STANDARD'S Superior Tooling.

TARGET gun drill features:

- Eliminates zero surface speed at center.
- Extremely rigid shank keeps drill straight.
- Accurate diameters and alignment will often eliminate secondary reaming operations.

ST SUPERIOR TECHNICAL SKILLS

At STANDARD that means:
DESIGN and ENGINEERING Know how...
TESTED, and PROVEN by EXPERIENCE...
with the IMAGINATION to solve tomorrow's METALWORKING PROBLEMS...TODAY!

STANDARD'S PERFECTION...*Quality...Dependability...Since 1881!*

The STANDARD Distributor in Your Area Stocks a Complete Line of High Production Rotary Metal Cutting Tools

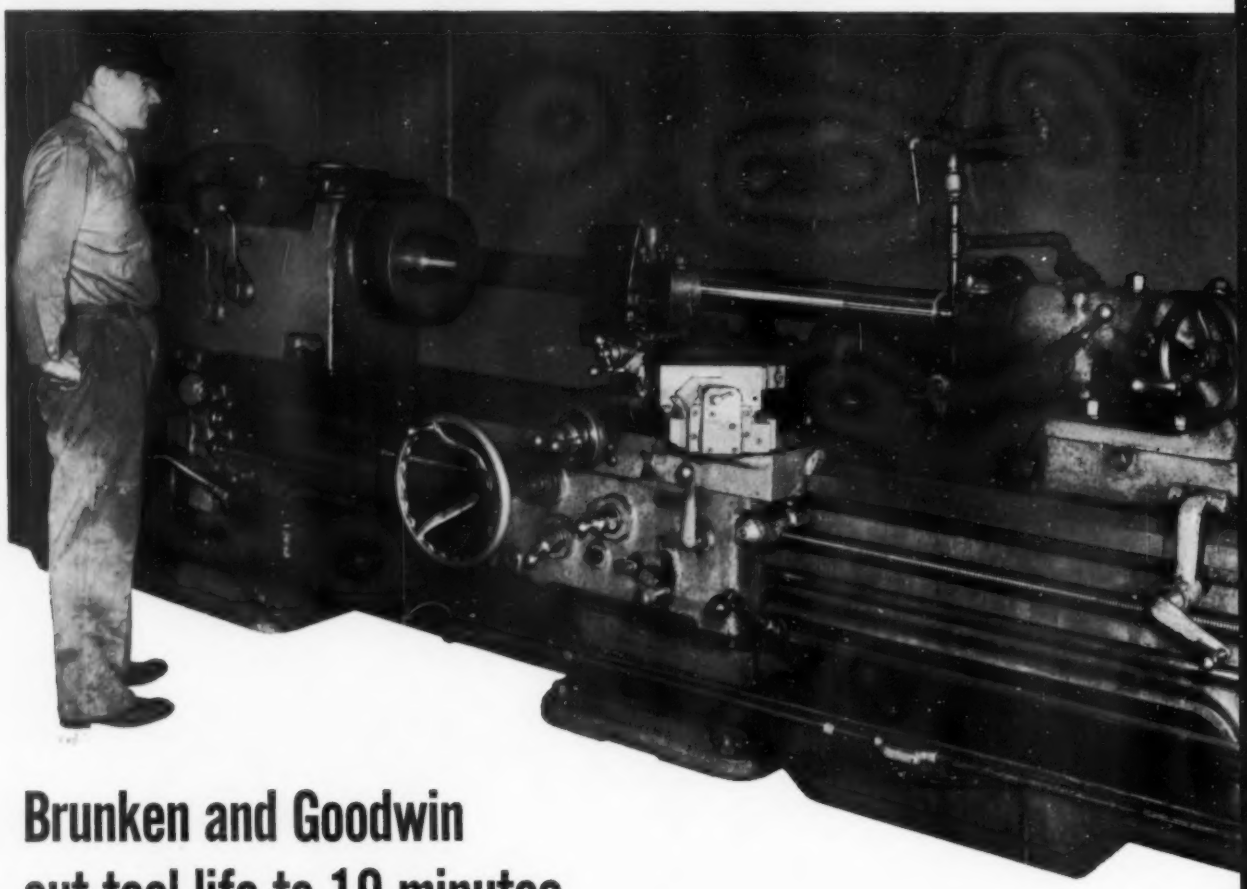
The STANDARD Quality Line • TWIST DRILLS • REAMERS • TAPS • DIES • MILLING CUTTERS • END MILLS • COUNTERBORES • CARBIDE TOOLS • GAGES • HOBS

STANDARD TOOL CO.

3950 CHESTER AVENUE CLEVELAND 14, OHIO

BRANCH OFFICES IN: NEW YORK • DETROIT • CHICAGO • DALLAS • LOS ANGELES • SAN FRANCISCO

DON'T WASTE $$$ IN YOUR



Brunken and Goodwin cut tool life to 19 minutes . . . and doubled this machine's output

Here is one example of improved profits made possible by sacrificing tool life to gain *top machine efficiency* and lower cost-per-piece.

At Brunken and Goodwin Tool and Engineering Company, Maywood, Illinois, a closely recorded test showed that the same operator, using identical equipment and tooling could produce over two times as much with a $2.63 reduction in cost-per-piece.

In the test set-up a 20hp Monarch Lathe was used to turn a piece of 8620 steel, 280 Brinell hardness, to 5" outside diameter. For the ⅛" depth of cut, Kennametal Grade K7H turnover type (throw-away) inserts with 6 edges were used throughout.

As shown in the table at right, this company reduced tool life from 120 minutes to 19 minutes. Tool insert costs thus increased from $1.18 per day to $7.45. But this expense means relatively nothing because production soared from 13 to 30 pieces per day—reducing cost-per-piece from $5.01 to $2.38—*a 48% decrease.*

Your Kennametal Carbide Engineer will gladly show you results from other actual tests. Ask him for more information on how you can trade pennies in tool costs for dollars gained from top machine output . . . or write KENNAMETAL INC., Latrobe, Pennsylvania.

	Before	Now
Tool life per edge	120 min.	19 min.
Machine cost/8-hr. day	$64.00	$64.00
Tool cost/8-hr. day	$ 1.18	$ 7.45
Cost per 8-hr. day	$65.18	$71.45
Pieces per 8-hr. day	13	30
COST PER PIECE	$ 5.01	$ 2.38

Write for booklet "There's Profit in Retiring a Tradition."

MACHINE OUTPUT TO SAVE ¢¢¢ IN LONGER TOOL LIFE!

There are hundreds of machine shops in the Nation today that could DOUBLE THEIR PRODUCTION OVERNIGHT, reducing costs and helping to relieve the squeeze on profits, by merely substituting a NEW IDEA in place of an old, traditional method they are now using.

All they have to do is to start operating their machines to get maximum OUTPUT . . . instead of operating them to get maximum TOOL LIFE. They are saving pennies through longer tool life . . . but they are wasting dollars in unused capacity of expensive machines, the unused talents of skilled operators and possibly in overtime costs to meet schedules.

This method of reducing costs by increased machine output is NOT an experiment. It doesn't call for you to be a guinea pig to try it. It has been PROVEN-IN-USE by dozens of progressive plants, and the results have been astounding.

Some of the dollars-and-cents results are recorded here. They can be duplicated in any plant that has good machines . . . and that is ready to challenge old ideas about tool life.

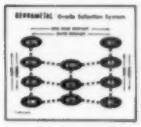
Just put yourself in the place of some of these successful users. Take a mental trial-balance, and estimate the savings you might make. Ask yourself this all-important question . . .

Which pays off best . . . long tool life . . . or top machine output?

Typical Examples—Same Machines . . . Same Tools . . . Same Workpieces								
	Job No. 1		Job No. 2		Job No. 3		Job No. 4	
	240-Minute Tool Life Setup	25-Minute Tool Life Setup	75-Minute Tool Life Setup	25-Minute Tool Life Setup	120-Minute Tool Life Setup	80-Minute Tool Life Setup	120-Minute Tool Life Setup	22-Minute Tool Life Setup
Machine Cost per Hour	$ 8.00	$ 8.00	$10.00	$10.00	$ 9.00	$ 9.00	$ 9.00	$ 9.00
Tool Cost per Hour	$ .04	$ .40	$ .36	$ .76	$ .14	$ .215	$ .14	$ .77
Cost per 8-Hour Shift	$64.32	$67.20	$82.88	$86.08	$73.12	$73.72	$73.12	$78.16
Pieces per Shift	51	181	8	17	94 hrs./pc.	41 hrs./pc.	8	16
Cost per Piece	**$ 1.26**	**$ .37**	**$10.36**	**$ 5.06**	**$859.16**	**$377.81**	**$ 9.14**	**$ 4.88**
Cost Reduction	70%		51%		56%		47%	

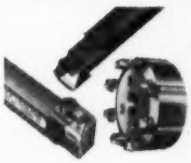
TO MULTIPLY YOUR MACHINE OUTPUT...YOU NEED THREE THINGS:

1. The "Three Man Tooling Team" that utilizes the specialized knowledge of your Tool Engineer, your Machine Operator, and the Kennametal Carbide Engineer *. . . to determine the right tooling for each job.*



2. The complete range of Kennametal* grades that provides not only the exact properties needed, but assures the uniformity of quality that permits *accurate prediction of tool life.*

3. Kendex* (patented) Tooling that provides instant insert change without having to re-position the tool. This is the key to this new method . . . *frequent tool change without excessive down-time.*



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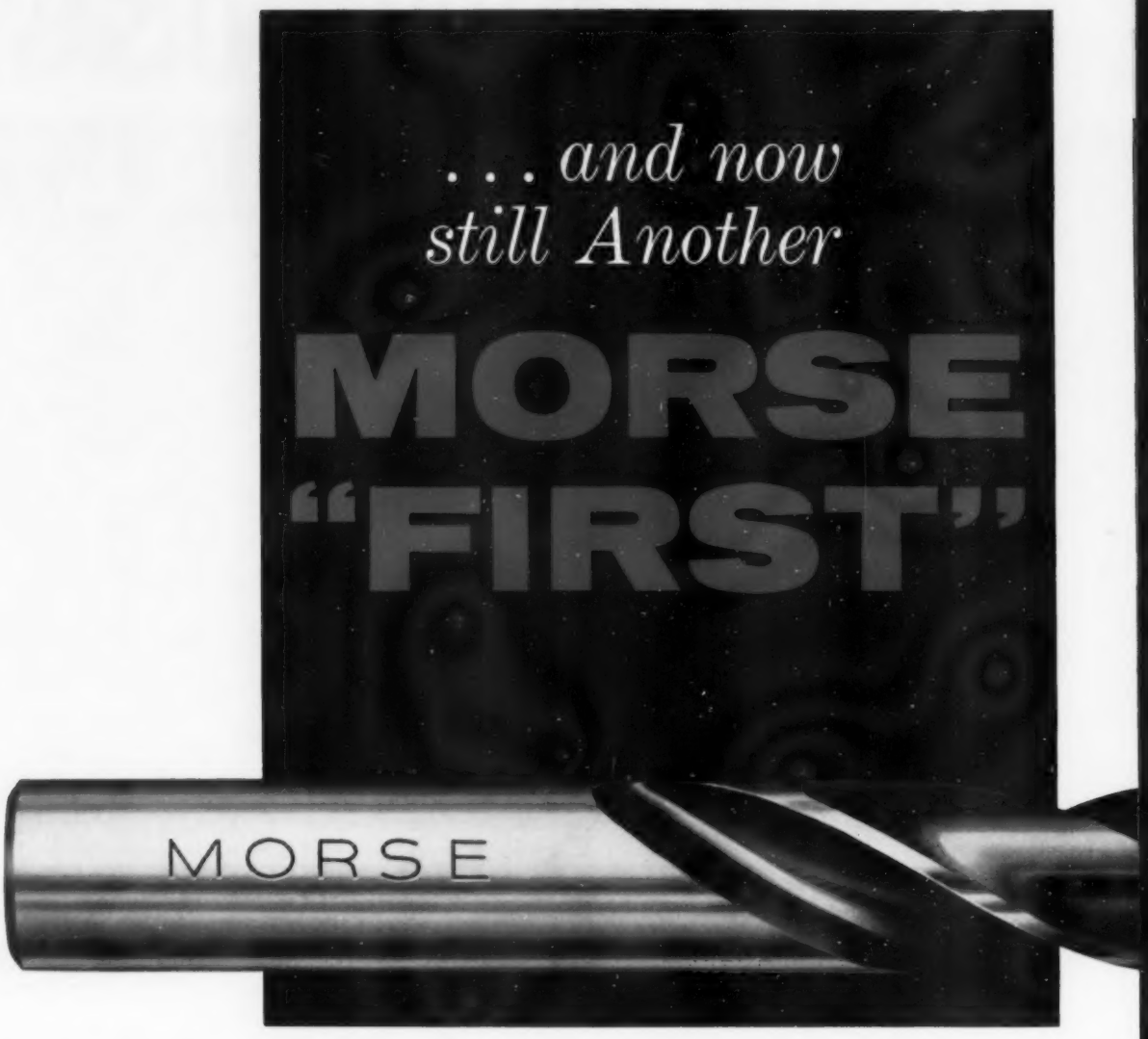
*Trademark

INDUSTRY AND KENNAMETAL

. . . Partners in Progress



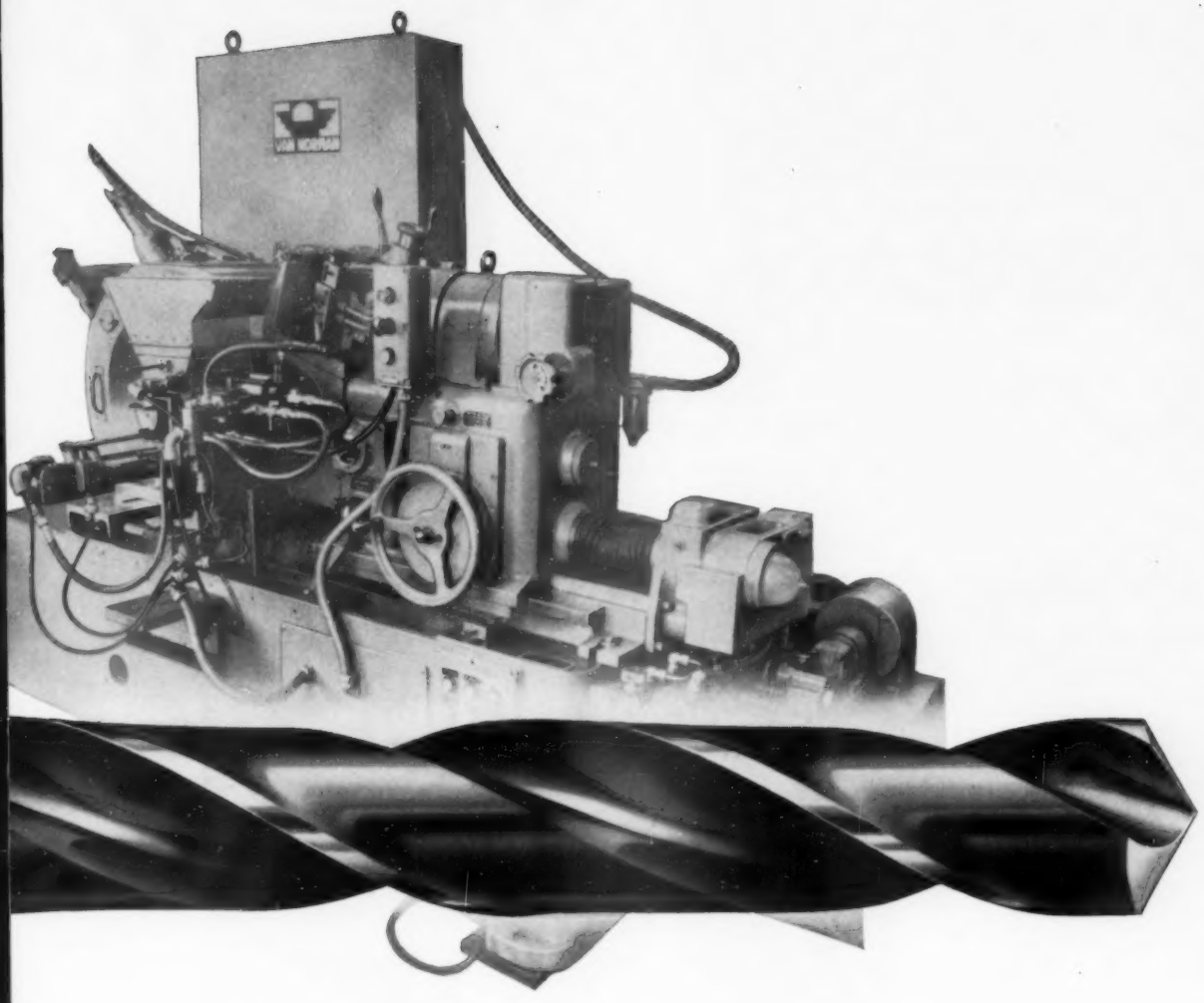
Quality Precision Grinding stepped VAN NORMAN Centerless Grinder

Ever since Stephen Morse produced the first twist drill, Morse has been the leader of progress in cutting-tool production methods.

Electrolizing . . . Vectormatic Taps . . . Morse's flute-grinding process . . . these are some of the Morse milestones in supplying better and better cutting tools to industry.

Now here's another step ahead . . . centerless grinding of drills on this new high-precision, high-production Van Norman Diversimatic machine, specially adapted to Morse requirements.

To *you*, this means *new high standards* of uniform quality and prompt delivery. See your Morse-Franchised Distributor *today*.



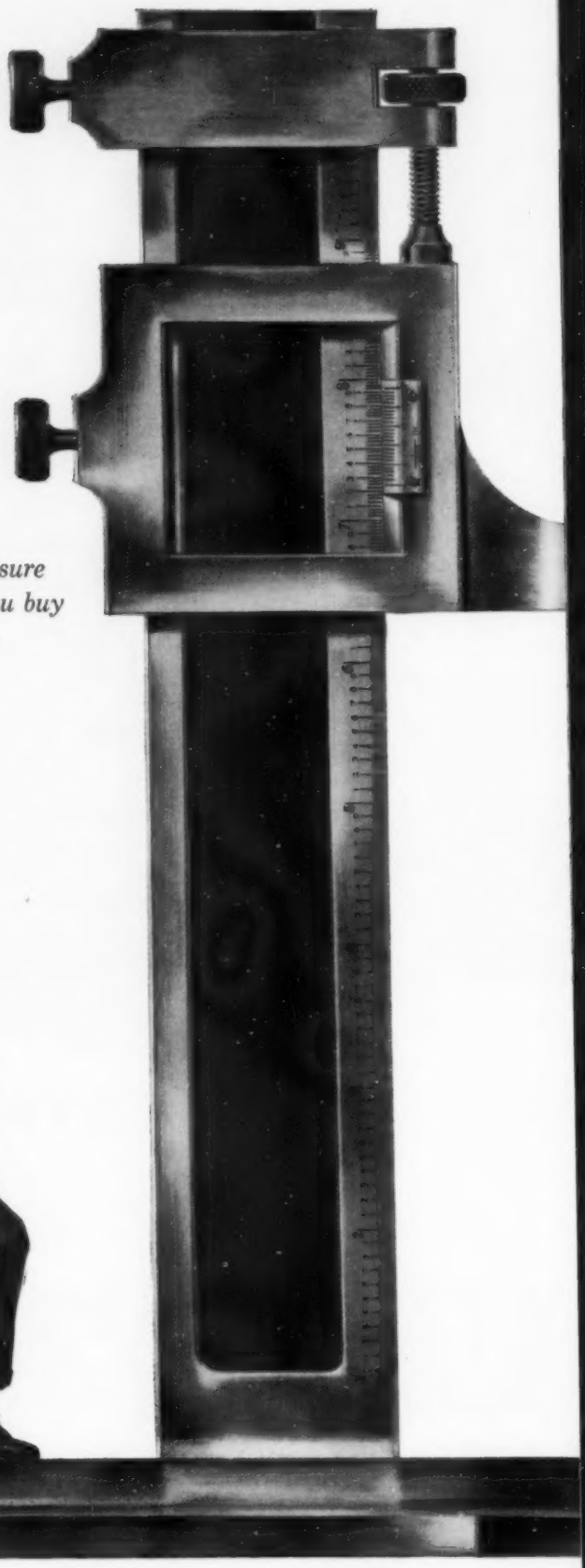
up with this NEW

MORSE *means* "THE MOST" *in Cutting Tools*

MORSE TWIST DRILL & MACHINE CO., NEW BEDFORD, MASS.

Warehouses in: New York • Chicago • Detroit • Dallas • San Francisco

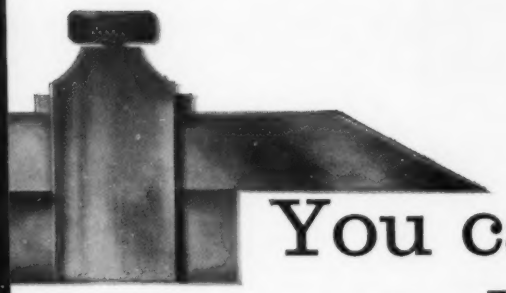
VN Division of VAN NORMAN INDUSTRIES, INC.



The Norton Measure of Value . . . the true measure of savings on materials you buy for your production is the cost-per-piece produced.

Call your Norton Man — he has the experience, the products, and knows how to save you money where it counts. There's a Norton expert in the fields of — abrasives . . . grinding machines . . . refractories.

NEW FROM FAIR STREET • HOME OF THE JIGMIL



You can produce greater savings than you can buy

You can't recognize a value by its price alone. This is true of all types of grinding wheels and has special significance in diamond wheels in view of their high initial cost.

The price tag on a diamond grinding wheel may appear to be a good "buy," but the real consideration should be what will you get for your money?

Less expensive diamond grinding wheels than Norton wheels may save you money on immediate cost. But if the lower cost wheels do not perform their jobs efficiently or cause production delays because of poor quality or wheel misapplication — the price you paid is too much.

The only accurate measure of the value of any grinding wheel is how much it produces for you per dollar cost — not merely how much you paid for it. Here is why Norton diamond grinding wheels are worth more to you —

Norton Company introduced all three diamond wheel bond types, does all its own sizing and checking of diamonds — duplicating wheel specification with constant accuracy. Norton certifies the carat content, assuring full value for your money. Whether the diamonds you use in carbide grinding are mined or man-made, Norton gives you the most advanced research engineering and manufacturing facilities in the entire abrasive field. And you get this great scope of detailed knowledge on a personal basis — your Norton Man.

Your Norton Man starts his career by spending a minimum of one year in a carefully planned training course in the Norton plant and a comparable period of training in the field. The Norton Man has an average of 15 years' abrasive experience in addition to the specialized training. He is the most knowledgeable man in abrasives that you can consult. Make him your consulting abrasive engineer.

Ask him to make an Abrasive Requirement Study for you. This study lists the correct specifications for each abrasive job in your plant to assure you lowest cost-per-piece produced. He is also available for complete field testing on specific problems. For example —

Your Norton Man can increase production by pointing out ways for more effective wheel usage. He has the widest selection of grinding wheels in the industry from which to select the best wheel for new product grinding operations and for improving your current grinding jobs — both at the lowest cost. And with Norton grinding wheels you can be sure of precise duplication order after order.

Norton offers true abrasive economy. Economy that pays off in lower cost-per-piece produced. Call your Norton Man. NORTON COMPANY, General Offices, Worcester 6, Massachusetts. Plants and distributors around the world.

W-1917

NORTON

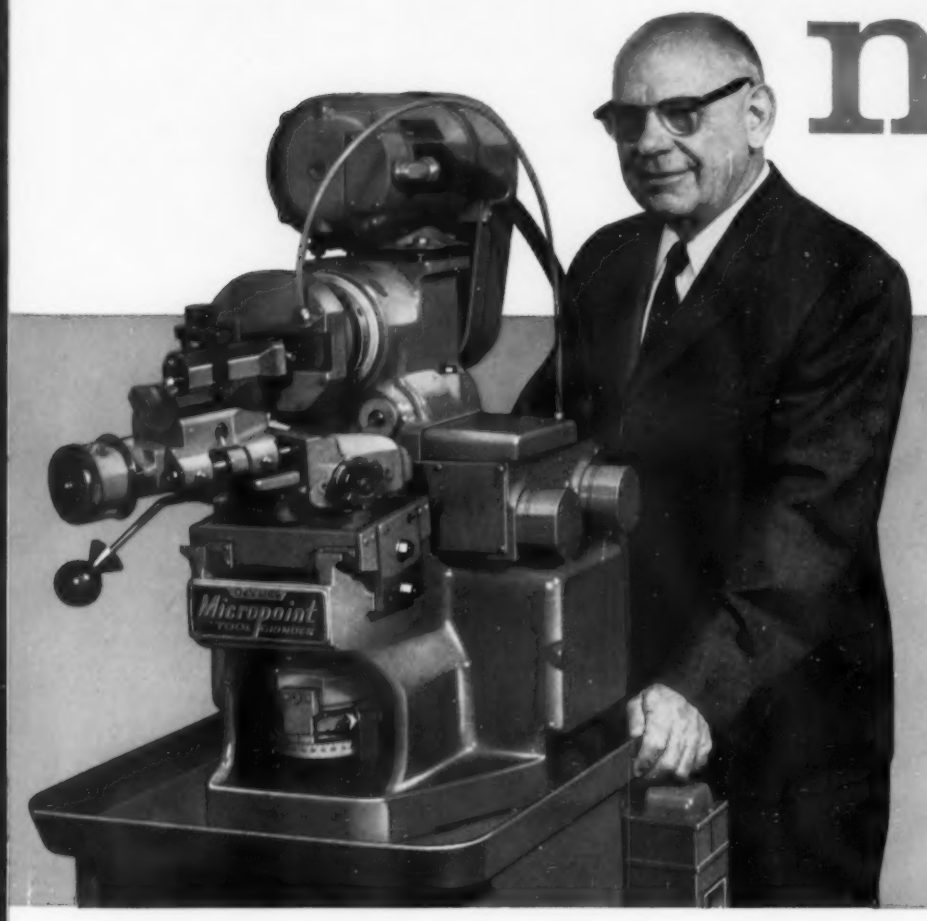
ABRASIVES

Making better products... to make your products better

NEW FROM FAIR STREET • HOME OF THE JIGMIL

mic

the first grinder



"Micropoint is the first machine in its field able to grind tool profiles geometrically correct to gage room accuracy"

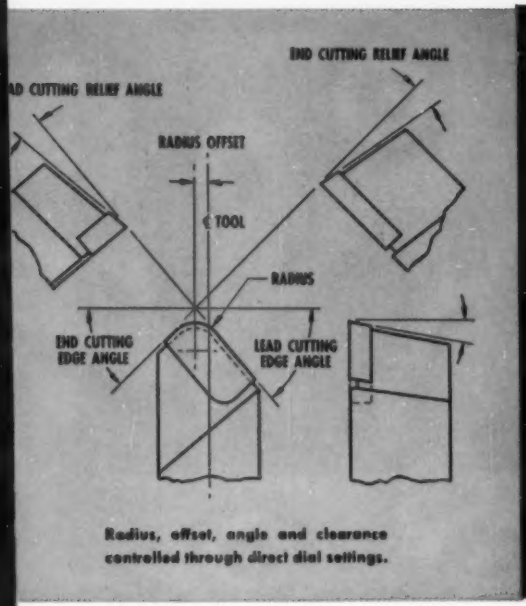
"MICROPOINT is not just another grinder. It's a precision machine that makes possible a new technique of single point tool grinding. Advantages of this new technique include greater cutting tool life, increased accuracy and output of machine tools and greatly improved uniformity and finish of the end product. Originally developed for our own use, MICROPOINT became necessary in our continuing pursuit of accuracy."

C. B. DE VLIEG

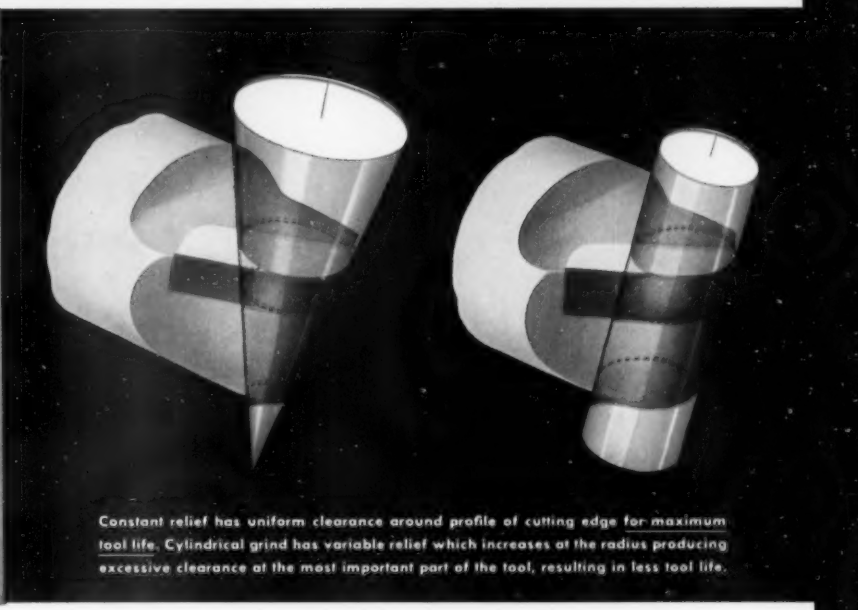
DE VLIEG MACHINE COMPANY, FAIR STREET • ROYAL OAK, MICHIGAN

ropoint®

capable of absolute control of tool geometry



Radius, offset, angle and clearance controlled through direct dial settings.



Constant relief has uniform clearance around profile of cutting edge for maximum tool life. Cylindrical grind has variable relief which increases at the radius producing excessive clearance at the most important part of the tool, resulting in less tool life.

DIRECT DIAL SETTINGS reduce the possibility of human error and provide a method of fast, simple, accurate adjustment for each radius, angle, offset and clearance in exact accordance with the geometric requirements of the tool. With a minimum of operator training, tool profiles can be controlled to .0001". Set-ups can be made quickly and with precise accuracy. Operators have ground as many as 300 identical tools in one set-up without corrective adjustment. Because of the machine's unique design, diamond wheel cutting life has been increased 4 to 6 times. Field tested for three years, many MICROPOINT grinders are already in use throughout industry. Available from your DeVlieg distributor.

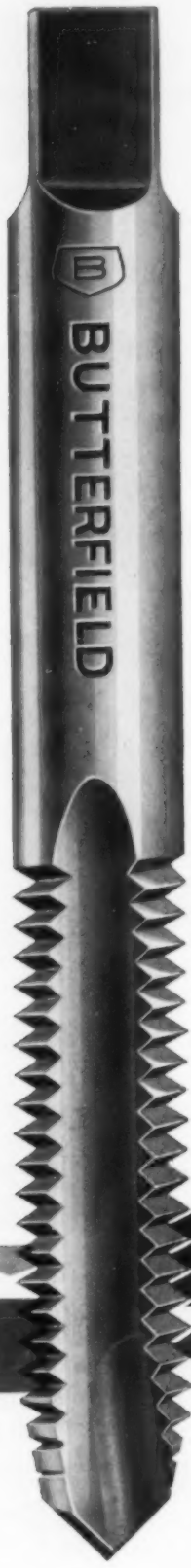
Write for Micropoint Tool Grinder Catalog

REWARDING REVELATIONS IN PRECISION
AWAIT YOUR VISIT TO FAIR STREET

DeVlieg

MICROPOINT® TOOL GRINDER

Geometrically correct tool points ground to gage room accuracy!



A PRODUCT OF SKILL

BUTTERFIELD
100%
INSPECTED
TOOLS

the complete line

With Butterfield taps, drills, reamers, dies, counterbores, cutters, end mills, hobs and carbide tools, service life is long and delivery time is short. Warehouses in Chicago, Cleveland, Detroit, Fort Worth, Los Angeles, New York and San Francisco. **Call your Butterfield Distributor.**

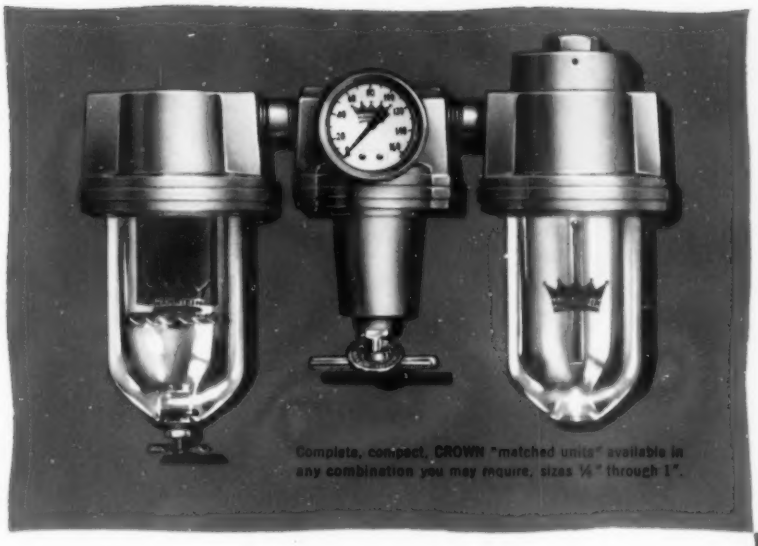
BUTTERFIELD

BUTTERFIELD DIVISION, UNION TWIST DRILL COMPANY, DERBY LINE, VERMONT

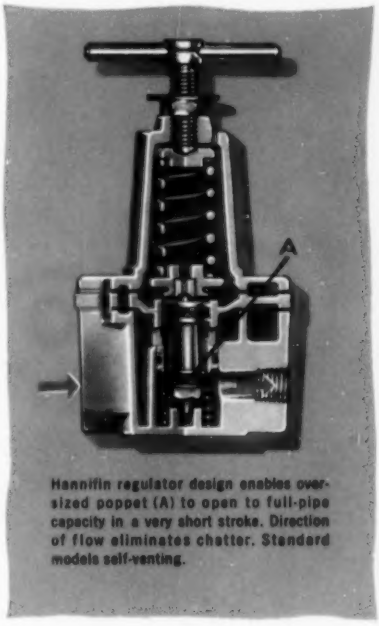
USE READER SERVICE CARD; INDICATE A-6-38

USE READER SERVICE CARD; INDICATE A-6-39

Crown From HANNIFIN air preparation units that don't waste air power



Complete, compact, CROWN "matched units" available in any combination you may require, sizes ¼" through 1".



Hannifin regulator design enables oversized poppet (A) to open to full-pipe capacity in a very short stroke. Direction of flow eliminates chatter. Standard models self-venting.

Hannifin CROWN "Combo" units – filters, regulators and lubricators in any combination – keep compressed air in the "pink of condition" without depriving you of needed air flow.

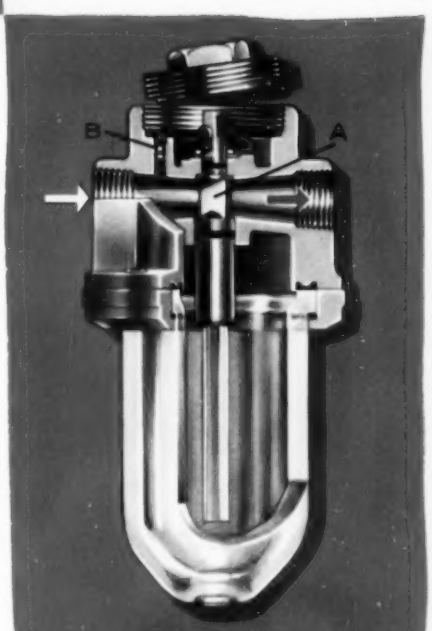
Crown regulators open fast on demand, close precisely when demand is satisfied, deliver the exact amount of air needed. Their "piston balanced" poppet design, which makes possible a flat, large-area, poppet-type valve with very short stroke, is the reason. The inherent stability of this design – no hunting or chatter – results in multi-million cycle life.

Crown filters have large, reusable filter elements for minimum resistance to air flow. Crown lubricators introduce predetermined amounts of oil into the air stream, automatically. Their design is so responsive to variations in air flow rate that the concealed, tamperproof adjustment is rarely used. This is the easiest lubricator of all to fill, and remote-fill models are available.

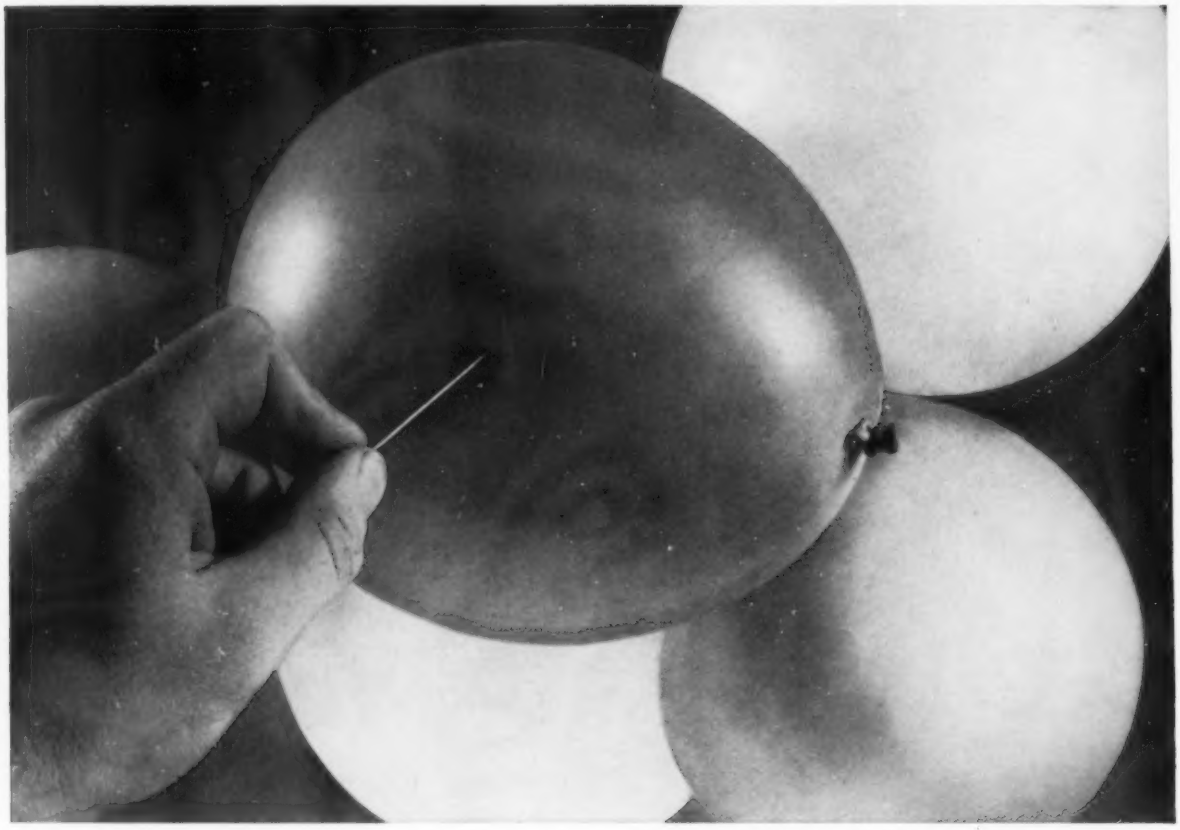
Crown units are competitively priced and stocked in principal industrial areas by Hannifin CROWN authorized distributors. For CROWN literature and the name of the distributor nearest you, write:

HANNIFIN COMPANY

535 South Wolf Road • Des Plaines, Illinois



Lubricator vane (A) is factory pre-set for most applications. Valve (B) shuts off air pressure to bowl when fill plug is removed. This patented Hannifin feature permits bowl refill without shutting down air line.



Machine Tool Buyers:

Beware the fallacy of projecting today's labor rates!

Almost without exception, machine tool replacement formulas employ an erroneous factor in computing savings — they are based on *today's* labor rates.

It seems basically sound to suggest, in the case of a contemplated investment in equipment, that a projection be made as to the estimated period over which the equipment is to be used.

Assuming this to be ten years, it is a fairly simple matter to project the *average* wage rate over the next ten years by using the historical increase for the past several years. This increase is known to be from 5 to 6% per year.

Using 5%, we then have a simple computation to determine the average projected wage rate which should be used in computing savings in a replacement formula.

Assuming a current wage rate of $2.50 per hour, this becomes $4.07 per hour at the end of ten years, or an increase of 62.8% over today's labor rate.

This percentage increase could reasonably be applied also to other factors in the computation of savings, such as indirect labor, fringe benefits, maintenance, etc.

In contemplating the purchase of a piece of equipment which will last for a number of years, it is fallacious, therefore, to compute savings in terms of today's costs only.

Does Jones & Lamson offer a positive approach; a realistic, workable formula that is free from fallacies such as this? *Yes!*

Write today for complete information.

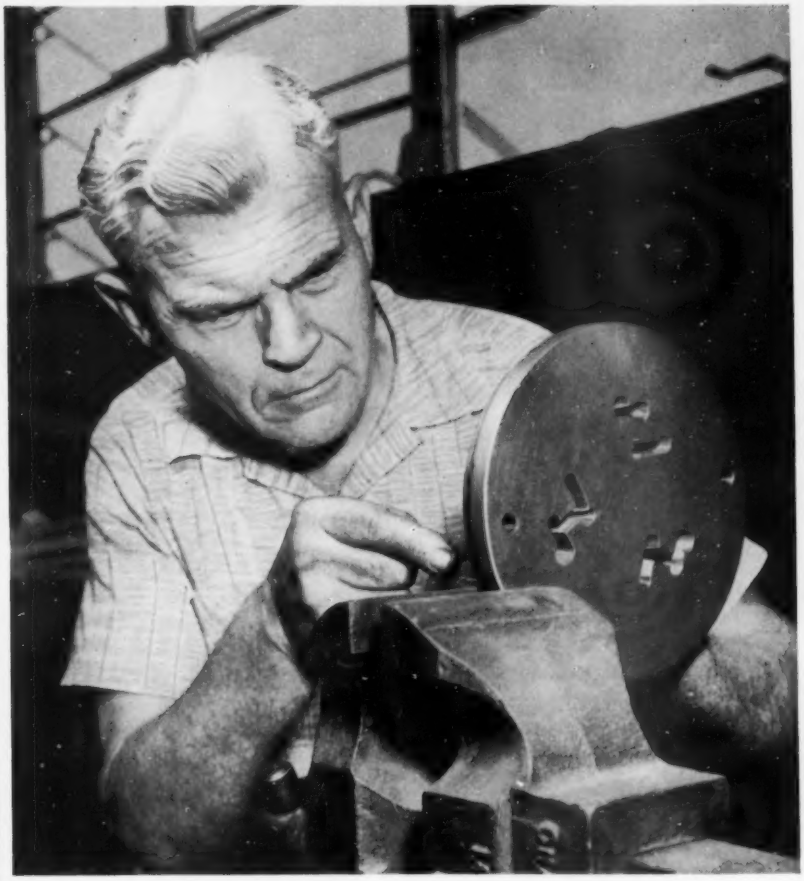
the man who needs
a new machine tool
is already paying for it

JONES & LAMSON Machine Company, 518 Clinton St., Springfield, Vt.

Turret Lathes • Automatic Lathes • Tape Controlled Machines • Thread & Form Grinders • Optical Comparators • Thread Tools

Tool Steel Topics

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.



Making "3-in. edge" extrusions with die of Cromo-WV

A manufacturer in the Southeast needed a long wearing hot-work tool steel to produce a "3-in. edge" extrusion made of aluminum. They talked it over with our local tool steel distributor who recommended making the die from a Bethlehem Cromo-WV upset-forged disc.

It was a good choice. The disc machined readily, and was easy to heat-treat. Hardened to Rockwell C47, the die extrudes 24 billets per hour, with brief stops for polishing. The life of the die is about 50,000 lb of extruded metal.

Cromo-WV, with its 5 pct chrome content, plus .30 pct vanadium, is a modification of our popular Cromo-W, the original 5 pct chrome hot-work steel. Resistant to heat checking, Cromo-WV also has good red hardness, and good shock resistance.

Like to give Cromo-WV a try? Just call your Bethlehem tool steel distributor. You'll find he will handle your request promptly.

BETHLEHEM TOOL STEEL ENGINEER SAYS:

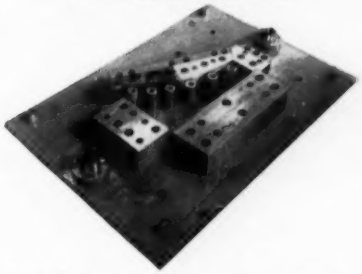
Drilled Holes Are Not Round (Usually)

Round holes which are drilled in tool steel stock with twist drills, if measured accurately, are usually found to be: 1. out of round; 2. oversize (compared with drill diameter); and 3. tapered throughout their depth. In other words a half-inch-diameter hole cannot be drilled with a half-inch-diameter drill.

This condition results largely from mechanical "play" in the drilling equipment, although many other factors can exert considerable influence. For example, if the two ground lips which form the cutting edges of a twist drill are unequal in length, the drill will produce holes of irregular size and shape.

The production of parts containing accurate round holes is most commonly accomplished by rough-drilling the holes undersize, and then either reaming or broaching to obtain the desired size.

Bethlehem Air-4 Is an Ideal Free-Machining Grade



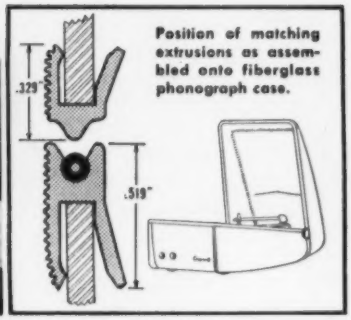
Air-4, Bethlehem's new medium alloy tool steel, is an ideal free-machining grade due to the addition of lead. It hardens in air at 1525F to 1575F, and provides excellent wear and high toughness. Air-4 is also a deep-hardening grade, with high compressive strength. Order it today from your Bethlehem tool steel distributor.

USE READER SERVICE CARD; INDICATE A-6-41

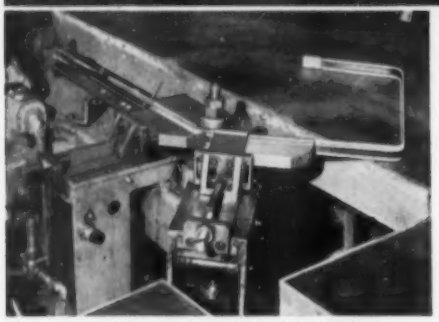
800 Bends An Hour

IN ANODIZED EXTRUSIONS ON PINES MODEL ¾ BENDING MACHINE

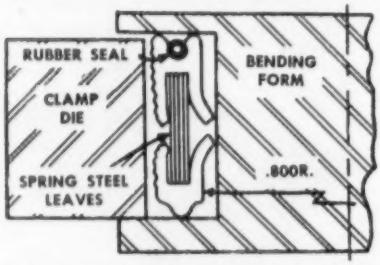
View of 12-year old Pines Model ¾ Bending Machine at Kinkead Industries Incorporated, Chicago, bending decorative aluminum extrusion closure strips.



Position of matching extrusions as assembled onto fiberglass phonograph case.



Close-up showing tooling employed in bending two matching extrusions simultaneously. Black strip separating two extrusions is spring-steel mandrel used to prevent collapse of open sections during bending.



Extrusions are positioned in tools as illustrated above. Die surfaces are nylon coated to prevent scratching the anodized finish. Rubber seal is installed in straight lengths before bending.

How Accurate Bending Simplifies Fitting of Scratch-Free, Matching Closures on Phonograph Cases

A unique tooling setup on a Pines Model ¾ Bending Machine enabled Kinkead Industries Incorporated, of Chicago, to fill an order for accurate 90° bends in matching aluminum extrusions. Bends are made simultaneously in a pair of extrusions at net production averages of 800 bends, or 100 pair of frames, per hour. Accurate forming simplifies corner fitting and assembly of the completed pieces used as closure strips on phonograph cases. As illustrated, the two extrusions are mounted on spring-steel strips which serve as an internal mandrel and prevent collapse of the sections in the bend area. Bending the two strips simultaneously assures perfect mating when assembled onto the fiberglass cases.

Ends Meet in Butt-Fit Without Trimming

Before bending, both of the extruded shapes are anodized to a beautiful, bright finish. Die surfaces are faced with nylon to protect the decorative finish and prevent marring during the bending operation. No lubrication is required. The uniform accuracy of the bending operation also eliminates any need for trimming the precut stock. The ends meet in a butt-fit. Kinkead's fine line of stainless steel and aluminum products, known as "Kintrim," is another example of the quality bending results that have long been achieved on Pines Benders. Look to Pines for the practical solution to *your* bending problems.

PINES ENGINEERING CO., INC.

Specialists in Tube Fabricating Machinery

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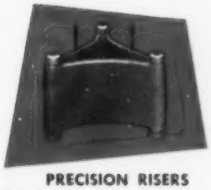
For case study reports on the cost-cutting advantages of cold forming the "Pines-Way," write for free copies of Pines News. For analysis on any job, ask a Pines representative to call.

PRODUCTION BENDING • DEBURRING • CHAMFERING MACHINERY

7 PLA-CHEK GAGES stand guard over Ford precision and accuracy in this Layout and Inspection room at Ford Motor Company's Dearborn engine plant in Dearborn, Michigan
1
2
3
4
5
6
7

7 of 200 Reasons Why Inspections are *Faster at Fords!*



PRECISION RISERS

Built with the same precision as the gages themselves, PLA-CHEK Gage Risers may be used to extend the usefulness of every PLA-CHEK Gage from the smallest to the largest size. Available in 6″ height for 6″, 12″, 18″ PLA-CHEKS . . . 12″ height for 24″, 36″, 48″ models.

MICROMETER THIMBLE

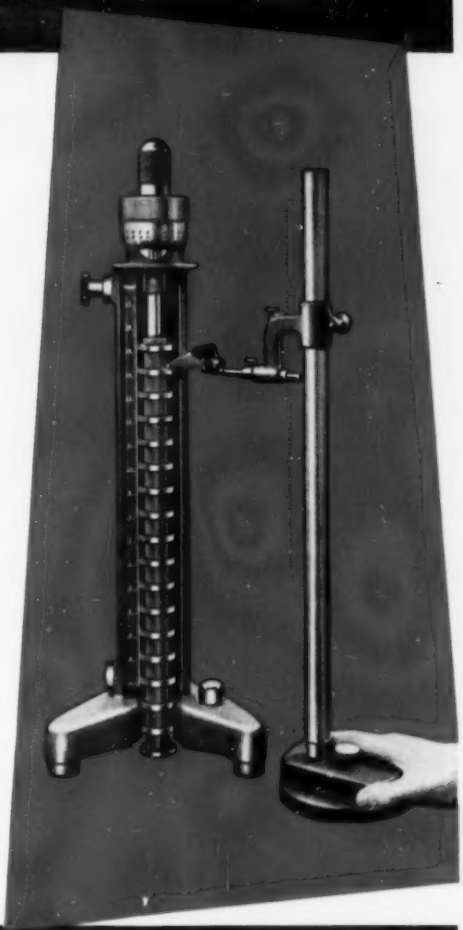
Is graduated to .0001″ and provides dimensions between 1″ steps on measuring bar. Measuring bar of the 18″ model (as illustrated) and larger models, can be adjusted to enable the user to take readings up or down relative to a center line or other reference line on the work.

PLA-CHEK GAGES Guard Ford Precision while Cutting Inspections from Minutes to Seconds

Precision is a law at Ford Motor Company. And speed is essential to the maintaining of high volume production. That's why you'll find more than 200 PLA-CHEK Gages at work in various Ford plants speeding inspections while guarding Ford precision and quality.

PLA-CHEK GAGES, available in a full range of sizes to meet every surface plate inspection and layout requirement, can be set 5 to 20 times faster than other methods of comparable accuracy. They are guaranteed accurate to .00005″ throughout the entire range of the 6″, 12″ and 18″ sizes and in the 24″, 36″ and 48″ sizes to .0001″ in any 24″ length or .0002″ over their entire range.

In August, 1946 Ford Motor Company purchased its first PLA-CHEK Gage. Today there are 200 at work in Ford inspection rooms and at Ford machines. Such confidence on the part of Ford Engineers must be deserved. Let us tell you how you, too, can speed inspections, maintain extreme accuracy and save money with PLA-CHEK Gages. Write for complete, detailed literature.



Cadillac GAGE COMPANY

P.O. BOX 3806 • DETROIT 5, MICHIGAN

Specify your finish...

enforce it with the Brush Surfindicator!

With the Brush Surfindicator you can hold finishes *exactly* to specifications. No costly rejects. You get a specification finish at minimum cost! The Brush Surfindicator with its full range of accessories precisely measures any finish regardless of whether it's rough, smooth, in a hole, on a concave or convex surface—even on a razor edge.

Write for booklet "Control the Finish and You Control the Costs." Factory-trained distributors in all major cities.

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DIVISION OF
37TH AND PERKINS CLEVITE CORPORATION CLEVELAND 14, OHIO

Our Cost Challenge!

Just invite us to bring the Surfindicator into your plant—put it to work on a machine—and we will prove that we can reduce your rejects. We're ready now!

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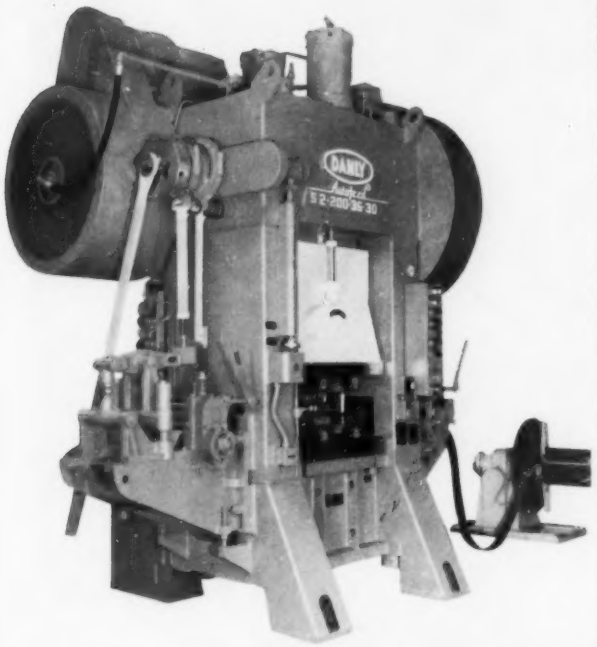
in PRESSES

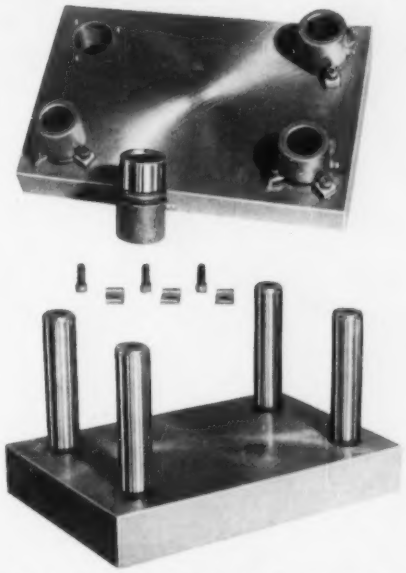


The report of the Business and Defense Service Administration shows that Danly led all producers of presses during 1957. Industry made Danly the first choice because you get lower operating costs with a Danly Press—you can depend on it! Each press is engineered to turn out more accurate stampings . . . to produce more units per shift . . . and to reduce profit-eating maintenance and spare parts inventories.

There are many new developments you should know about, such as the Quick Die Change feature available on all Straight Side Presses . . . single, double and triple action . . . the modern high-production Autofeeds . . . and the completely modern line of Open Back Inclinable presses just introduced. See how Danly can help you reduce costs and give your products the stamp of leadership!

Write for the new Autofeed Catalog that gives full information on Danly Presses for high-production stampings.

in DIE SETS and Die Makers' Supplies



With the introduction of the Demountable Bushing Die Set, Danly is now working on its fifth million in die set production. Included in this production are die sets mounted in five Danly Autofeed Presses that produced a million pieces per grind with an average of 219,000 pieces per .001 inch of die grind.

In every instance, Danly can meet your most exacting diemaking specifications with a die set—standard or special. Since pioneering the first mass-produced precision die sets 36 years ago, Danly has continuously developed new production, inspection and distribution methods to serve you better.

Today, there's the new Danly Die Set with Demountable Bushings being assembled in a factory branch or distributor assembly plant near you. It is your fast, convenient source for toolroom and pressroom supplies that bear the stamp of leadership. Danly facilities for special Die Set manufacture are also improved and expanded .

Send for money-saving facts. Write us and your distributor or branch will give you helpful information on Danly Die Sets.

DANLY MACHINE SPECIALTIES, INC.

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DANLY

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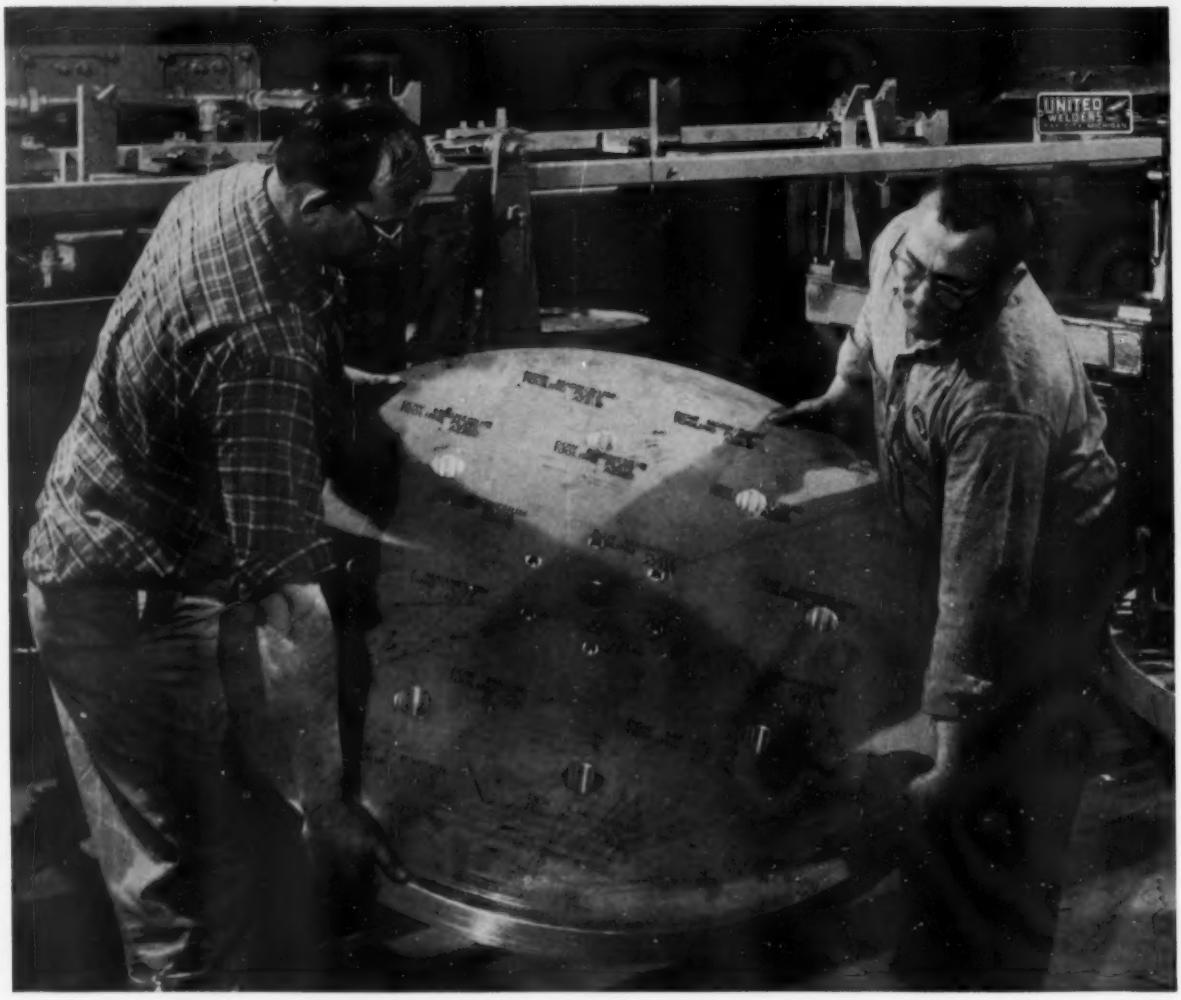
DOW | MAGNESIUM PRODUCTS

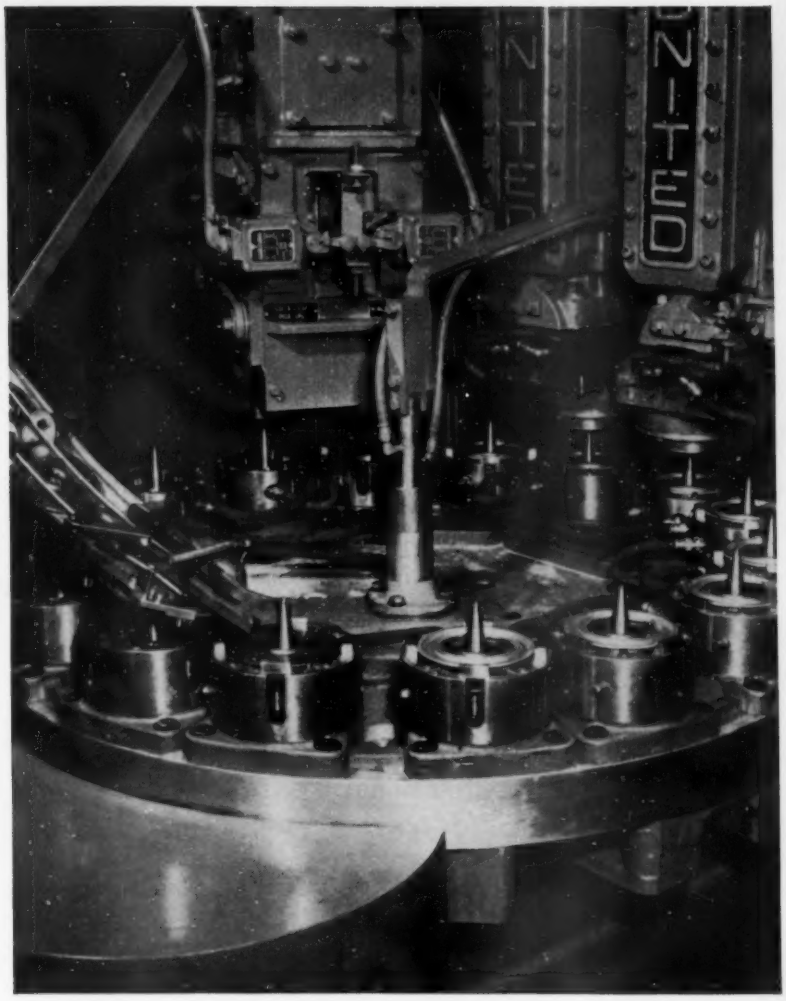


10¢ PHONE CALL CUT MACHINING TIME 50% ON 3-FT. INDEX TABLE!

Ordered-by-phone magnesium tooling plate disc replaced cast steel index table for machinery manufacturer . . . "as purchased" flatness cut previous machining time on this part in half . . . saved 50% on machining costs.

United Welders Inc., of Bay City, Michigan, recently replaced steel with magnesium tooling plate in making the precision index table, or dial, for their automatic 8 Station Dual Dial Welder. This machine is used in welding the bottom gasket retainer for an oil filter assembly in 1959 automobiles.

The dials previously were made of cast steel which required costly, time-consuming surface and edge machining to finish. The 2½ inch by 36 inch dials of magnesium tooling plate are now purchased rough-cut to size from the local Dow magnesium distributor, and are finished by simply edge truing and drilling. Because the as-purchased flatness completely eliminates need for surface machining, United's machining costs on this part have been cut by more than half. Production has been speeded, too, because magnesium's light weight makes the dials easy to handle during manufacture. Two men can easily lift and handle the light disc. Cranes or lift trucks aren't needed as they were with the previous steel dials.



LIGHTNESS CUTS POWER NEEDS 75%

In the United welder above, the dial starts and stops 500 times per hour during welding operations. This lightweight magnesium dial requires only a quarter of the power needed to operate the previous steel dial. It permits a drastic reduction in the cost and size of motor, speed reducer and other necessary driving elements.

RIGIDITY MEANS ACCURATE POSITIONING

United Welders employs a Geneva Stop Movement to position parts accurately under dual automatic spot welding heads. Magnesium's rigidity helps the dial retain close tolerances necessary for continued accuracy.

Magnesium tooling plate has other advantages, too. It costs less to buy than other lightweight tooling materials and can easily be welded. It can often be obtained ready-cut-to-shape from distributors, saving additional time in your shop.

Because magnesium tooling plate is uniformly flat, it can be used for almost all tooling jobs without surface machining. It's rolled and thermal flattened to close flatness tolerances . . . high dimensional stability keeps it flat in use.

MAGNESIUM TOOLING PLATE IS AVAILABLE FROM STOCK AT:

E. F. Bailey Company
Seattle, Washington

Clendenin Bros., Inc.
Baltimore, Maryland

Copper and Brass Sales, Inc.
Cleveland, Ohio; Detroit 12, Michigan

Fullerton Steel and Wire Company
Chicago 35, Illinois

Hubbell Metals Inc.
St. Louis 3, Mo.; Kansas City, Mo.; Marietta, Ga.

A. R. Purdy Co., Inc.
Lyndhurst, New Jersey

Reliance Magnesium Company
Los Angeles 58, California

Joseph T. Ryerson & Son, Inc.
Dallas, Texas

There's a wealth of information in Dow's new magnesium tooling plate manual. This handy 56-page book is filled with facts about shop working characteristics, machining, etc. For a copy, contact your Dow branch office or write to Magnesium Sales, Department 1331FJ6.

THE DOW CHEMICAL COMPANY · MIDLAND, MICHIGAN

ALBRE

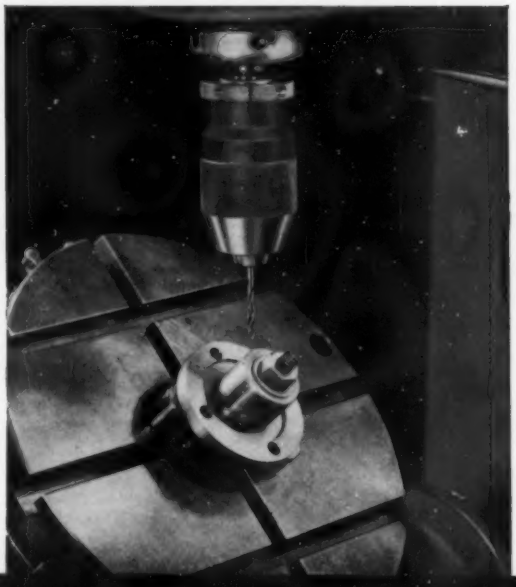
The world's most accurate keyless

On milling machine

The Albrecht Drill Chuck at work in production and in the tool room.

On high speed sensitive drill

Model 15 for small drills (.008" shank)



On jig borer

CHT

drill chuck!

Albrecht Heavy Duty Drill Chuck

8 threaded back models—capacities 0-⅝"

12 taper mounted models—capacities 0-⅝"

Now available in threaded back models for portable tools

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SERVING INDUSTRY ECONOMICALLY
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A PARTNERSHIP IN PROGRESS

Your industrial supply distributor makes it his business to know your business. He is always available and ready to fill your needs quickly, dependably and economically. When you need chucks, you can depend upon Jacobs and the Jacobs industrial supply distributor who works with you . . . your partner in progress through service.

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Jacobs
CHUCKS

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why make parts the slow, costly way?

COLD-HEAD THEM!

Steel

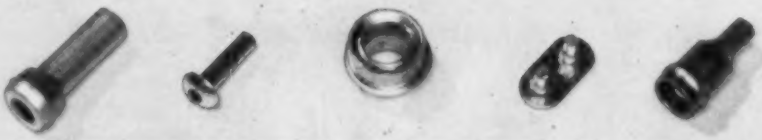
Tappet plunger, splined square-head shaft, collar for adjustment wedge, universal joint bearing cup, pipe plug, spark plug body.

Copper

Ornamental stud, distributor cap center insert, commutator bar, wire clamp, solenoid contact, starter field terminal.

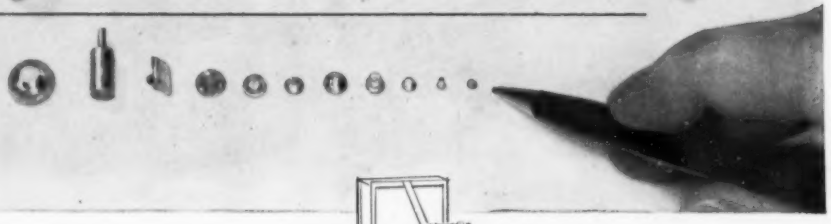
Aluminum

Hollow rivet, blind rivet, flanged collar, link, distributor cap outside insert.



Precious Metals

Electrical contact, transistor case, miscellaneous rivets and electrical contacts.



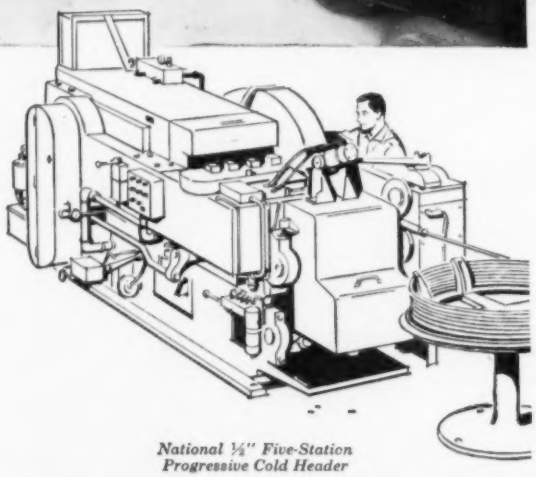
Of various metals, the parts identified above were developed for fast, accurate production on National Cold Headers.

Most of these important jobs are made without waste, ready for end use. All are cold-forged from coiled wire – start-to-finish in one compact Header – without any intermediate steps.

New technical break-throughs are making jobs like the above every day commercial realities. More workable wire, better lubricants, improved die materials and vast engineering experience are combining to adapt formerly difficult work to modern, profitable methods.

Whether you now have Headers or not, send us prints or samples of your jobs, or bring them to Tiffin where more of our people can help with *your* problem.

Perhaps up-to-date Cold Heading, a truly fast-growing process in metalworking, can pay off for you.



National ½" Five-Station Progressive Cold Header

Founded 1874—DESIGNERS and BUILDERS of MODERN FORGING MACHINES • MAXIPRESSES • REDUCEROLLS • COLD HEADERS BOLTMAKERS • NUT FORMERS • TAPPERS • NAILMAKERS CO-PIONEERS WITH INDUSTRY OF ADVANCED METALWORKING PRODUCTION METHODS

NATIONAL MACHINERY CO.

TIFFIN, OHIO, U. S. A.

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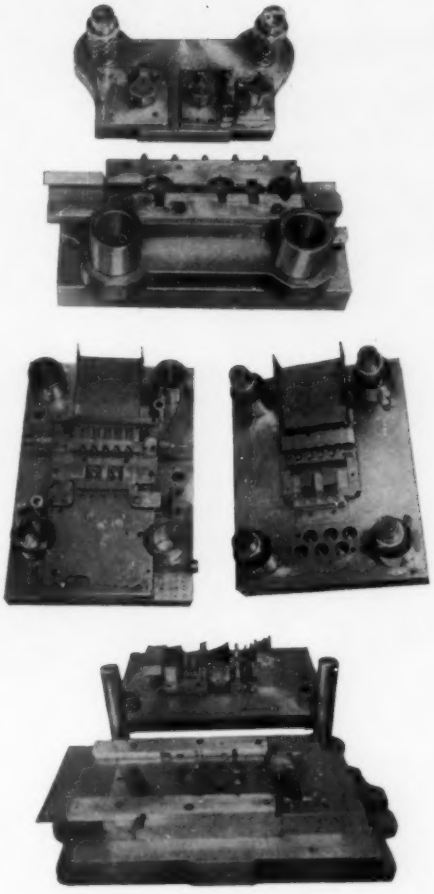
Produced by

LATROBE

for long-run dies...



Metalmasters

Fully-Uniform . . . Free-Machining DESEGATIZED®

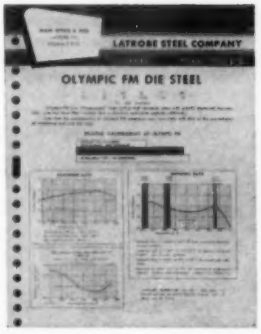
OLYMPIC FM

High Alloy Die Steel

When your die production calls for long-run service . . . and you need a die steel that yields a superior machine finish without tearing—one that has excellent non-deforming characteristics in heat treatment . . . that's the time to use Latrobe's OLYMPIC FM.

OLYMPIC FM is an air hardening 12% chromium (D-2 type) die steel made to exacting standards by Latrobe Metalmasters . . . guaranteed to be fully-uniform in the distribution of wear-resisting carbide particles and alloy sulphides for better machinability . . . a result of Latrobe's exclusive DESEGATIZED® process of manufacture!

There's a wide range of Olympic FM sizes stocked at branch warehouses near you—Call today!



Or send for Olympic FM Data Sheet today!

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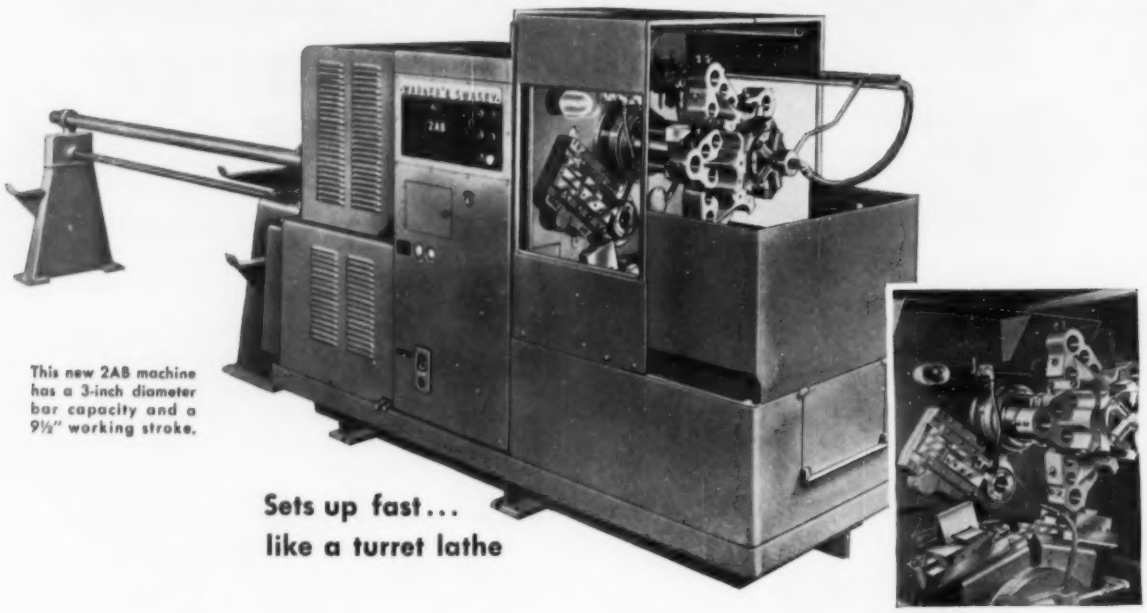
NEW! Warner & Swasey 2 AB Single Spindle Automatic Bar Machine

...provides fast, automatic production of short, medium, or long-run precision bar jobs



This new 2AB machine has a 3-inch diameter bar capacity and a 9½" working stroke.

Sets up fast... like a turret lathe

Now, the shop-proven, cost-cutting features which have made Warner & Swasey Automatic Chuckers so outstanding in their field are available in a new Single Spindle Bar Automatic. Most important among the profit- producing features of this new Warner & Swasey 2 AB are:

● **FASTER SETUPS**—With no cams to change, time-consuming set-up procedures, usually encountered with automatic bar machines, are eliminated. Even your smallest lot bar jobs can now be produced economically on an automatic basis.

● **GREATER ACCURACY**—Only two wide—and widely-spaced—bearing surfaces support the turret. Thus, cumulative tolerance problems in conventional "multiple bearing" turret location designs are eliminated.

● **EASIER TOOLING FOR COMPLEX WORK**—Flexibility and accessibility of the 2 AB's cross slides and pentagon turret enable the use of a wide variety of machining methods. One operation usually handles even the most complex workpieces.

● **POWER FOR TOMORROW'S JOBS—TODAY**—The 2 AB's 25 horsepower, reversible motor more than meets today's rugged metal removing requirements and, coupled with a wide range of spindle speeds, permits the efficient application of the latest cutting tool materials.

● **"FREE" CUT-OFF TIME**—An independently-operated cut-off slide allows full utilization of both front and rear cross slides. The cut-off cycle may be started during any one of the pentagon turret stations. Thus, cutoff can be progressing during subsequent machining providing a cut-off cycle which is virtually "free".

● **AUTOMATIC RESTOCKING INDICATOR**—This ingenious device in the hydraulic bar feed mechanism automatically stops the 2 AB and lights an indicator light on the operator's control panel before the bar being machined runs out—prevents tool damage from improperly-gripped stock.

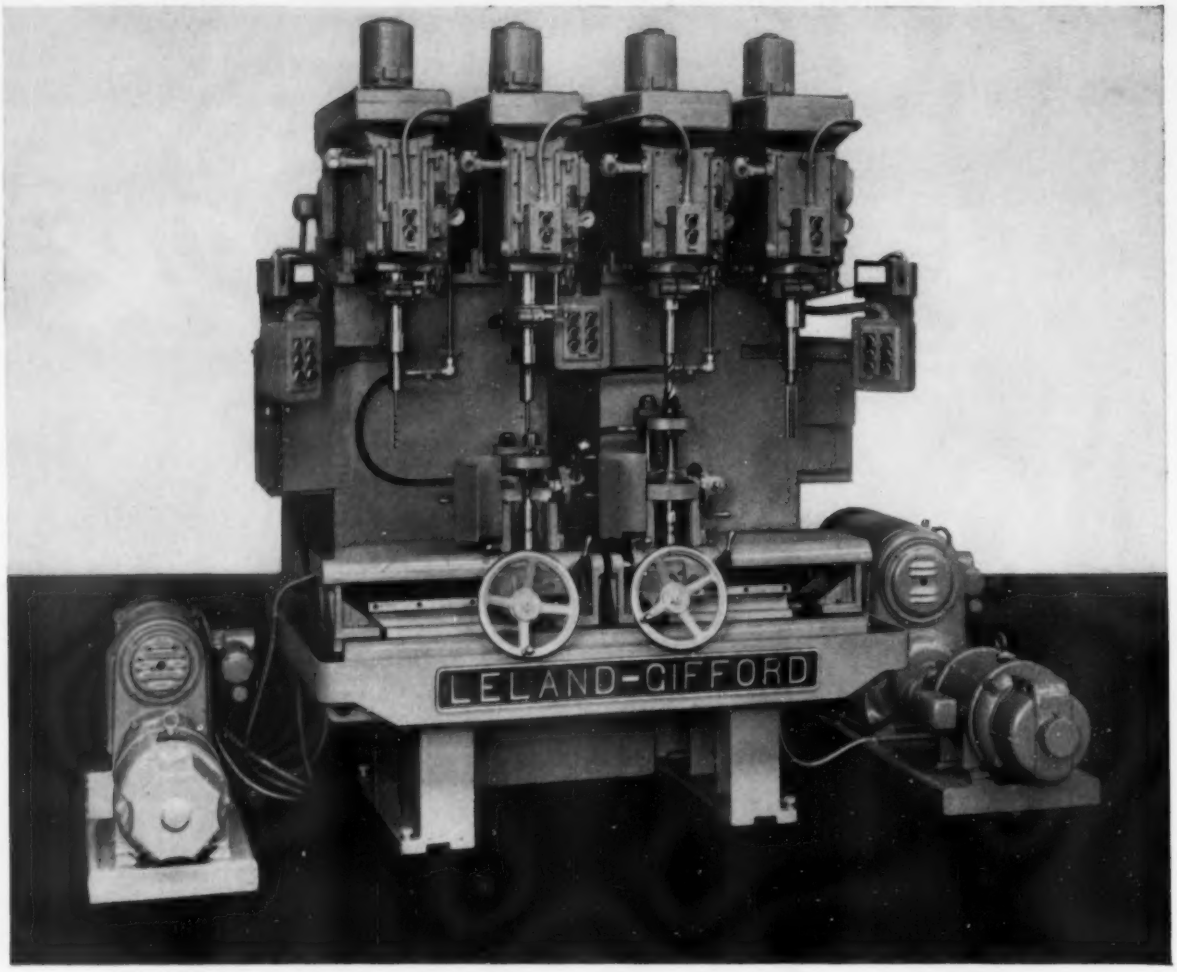
Why not call your nearest Warner & Swasey Field Representative and get the complete story on the new 2 AB. It can help increase both production and overall profits—so important in today's highly competitive picture.

WARNER & SWASEY
Cleveland
PRECISION MACHINERY SINCE 1880

NO MATTER WHICH WAY YOU TURN...WARNER & SWASEY CUTS COSTS

Today O K Tool offers one of the most comprehensive lines of milling cutters in the industry. It consists of many "firsts": the first single-point tools with interchangeable tool bits for lathe, planer, shaper and boring mill jobs; the first milling cutters with tapered and serrated blades; the first shankless single-point tools. Recently these have been supplemented with quick-change wedge-type milling cutters and over 750 kinds and sizes of solid tools, making a total of over 3000 tools designed to better serve machine shops everywhere. Free catalogs: ☐ single point tools, ☐ milling cutters, ☐ solid cutters. The O K Tool Company, Inc., 400 Elm Street, Milford, New Hampshire.

OK *modern milling* *cutters for* *modern* *milling machines*



Designed for maximum utilization —

It goes without saying that Leland-Gifford special drilling machines deliver the production you want to the precision standards you set. But Leland-Gifford also has in mind the importance of design for maximum utilization to make your purchase of a Leland-Gifford machine a gilt-edge, quick return investment.

For Automatic Drilling at its best . . . be sure to see Leland-Gifford

CALL THE OFFICE NEAR YOU

THE JOB: Drill and ream a complete line of screw machine master collets and feed fingers ranging from $\frac{1}{8}$" to $1\frac{1}{4}$" diameter.

THE MACHINE: A dual operating Leland-Gifford special with two work-holding fixtures and four standard self-contained drilling units equipped for either plain or step feed. Workpieces are drilled in one location, indexed to second location and reamed. Spindle speeds are precisely controlled through variable frequency input to ac spindle motors. Hydraulic feed is infinitely adjustable with separate motors driving hydraulic pumps at constant speed regardless of spindle speed.

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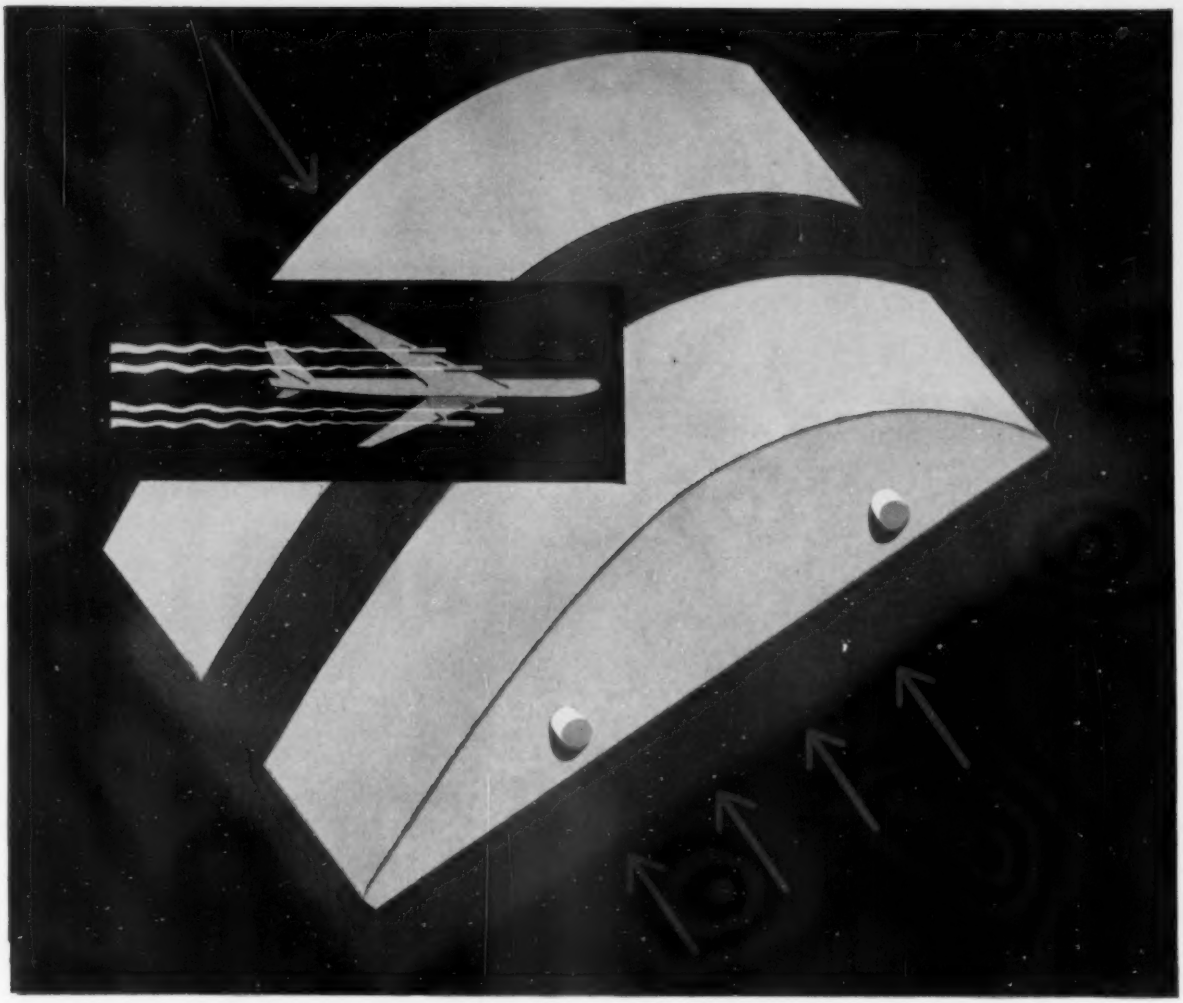

Save up to 30% in cost, 60% in time with **EPON® RESIN** tools and dies

Your tooling resin formulator will show you how Epon resin formulations save time and money in applications such as these:

High temperature tooling: Metal forming stretch dies that can operate at temperatures over 400°F.

Heated tools: Matched dies, with integral heating units, may be made with Epon resin formulations for rapid heat curing of laminated plastic parts.

Long-lasting metal forming tools: Castings made of formulated Epon resin, mounted in a crank press, showed no permanent deformation after 28,000 compression-shock cycles.

In addition, Epon resin formulations offer you the following advantages:

Excellent tolerance control: Little machining and handwork are required to finish Epon resin tools because of the material's excellent dimensional stability and lack of shrinkage.

Outstanding strength: Jigs and fixtures with thin cross sections can be built from Epon resin-based formulations rejnforced with glass cloth. The resulting laminate has high flexural strength and excellent dimensional stability.

Easy modification: Tools and fixtures made from Epon resins may be quickly and easily modified to incorporate design changes.

CONTACT YOUR TOOLING RESIN FORMULATOR

The combination of resin formulator's skill and practical knowledge, backed by Shell Chemical's technical research and experience, has solved many important tooling problems for industry. Your own formulator specialist can help you solve yours. For a list of experienced tooling resin formulators and additional technical information, write to:

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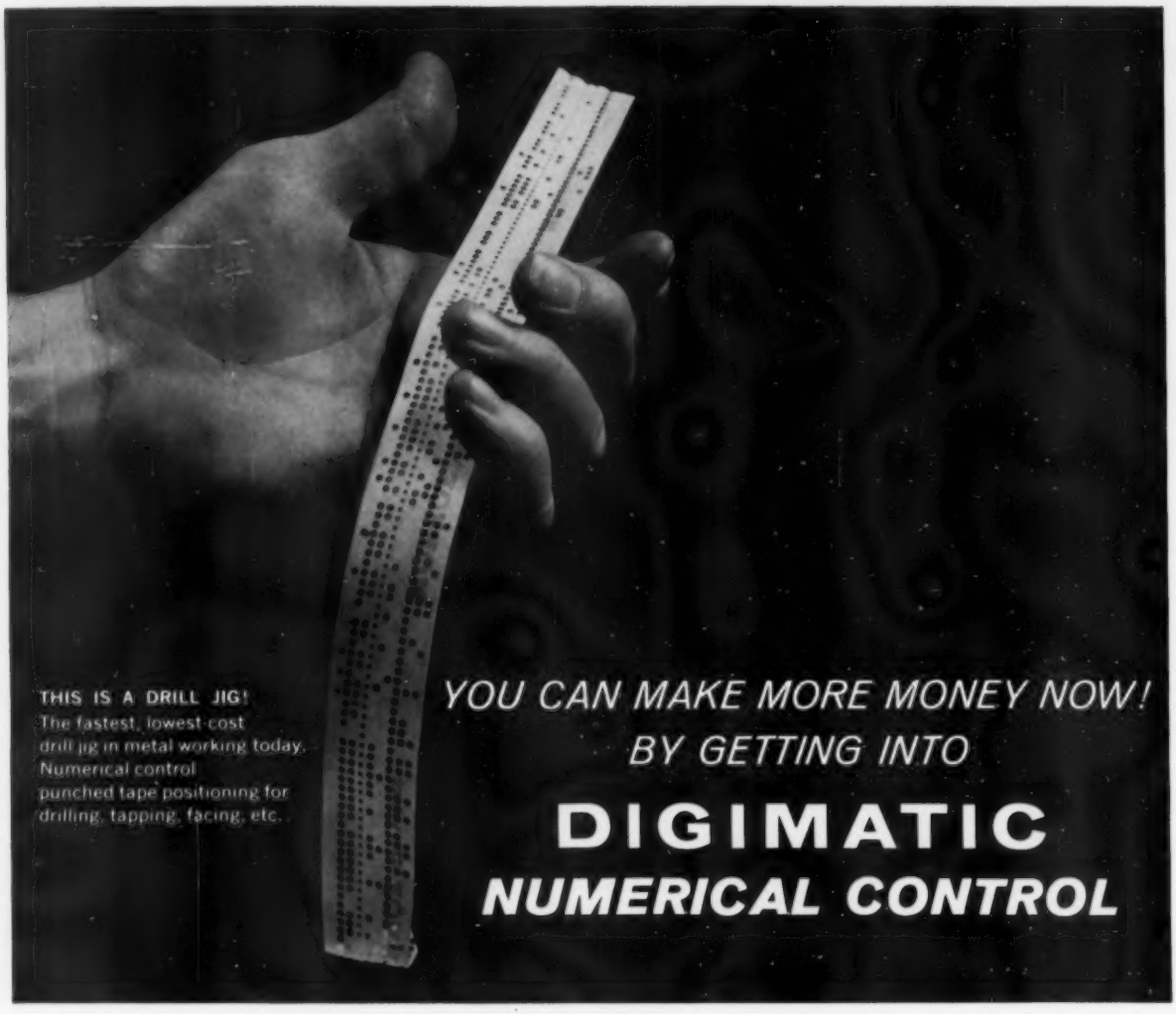
THIS IS A DRILL JIG!
The fastest, lowest-cost drill jig in metal working today. Numerical control punched tape positioning for drilling, tapping, facing, etc.
YOU CAN MAKE MORE MONEY NOW!
BY GETTING INTO
DIGIMATIC
NUMERICAL CONTROL

If you make a variety of parts, in small quantities (1-2000), and often have engineering changes—DIGIMATIC* 202 by Stromberg-Carlson can drastically reduce the cost per part. Here's why.

1. Reduces lead time—because tapes can be made much faster than drill jigs.

2. Cuts down on inspection time—because tape controls are *exactly* repetitive. There's no fatigue factor.

3. Shorter set-up time—only simple holding fixture required.

4. Eliminates scrap and rework due to human error.

In a typical application, the total cost per part for the production of forty parts was reduced from $7.87 to $3.29.

But more important, an engineering change order was effected in 15 minutes at a cost of $1.15 as opposed to conventional retooling costs of $38.40. A saving of 97%!

Every factor that would influence this cost has been considered. The cost of additional floor space, insurance, power, etc., and amortization required over the present machine tool for the DIGIMATIC 202 Control System is included. Complete details and photographs furnished on request.

The only complete, standard system. The DIGIMATIC Control System includes all equipment necessary for numerical control operation. It includes: *Special Punch Tape Preparation Unit* that is as simple to operate as an adding machine. No complicated computer language to learn. *Control Console*—compact unit, operator maintained, with shop-proven reliability. *Servo Table*—can be adapted to any existing machine in one day. Automatically positions work on ball bearing ways accurately and rigidly within 1½ seconds per hole.

Write for free 12-page booklet, **"DIGIMATIC Model 202"** containing complete details and illustrations. Also—movies shown at your shop or plant on request.

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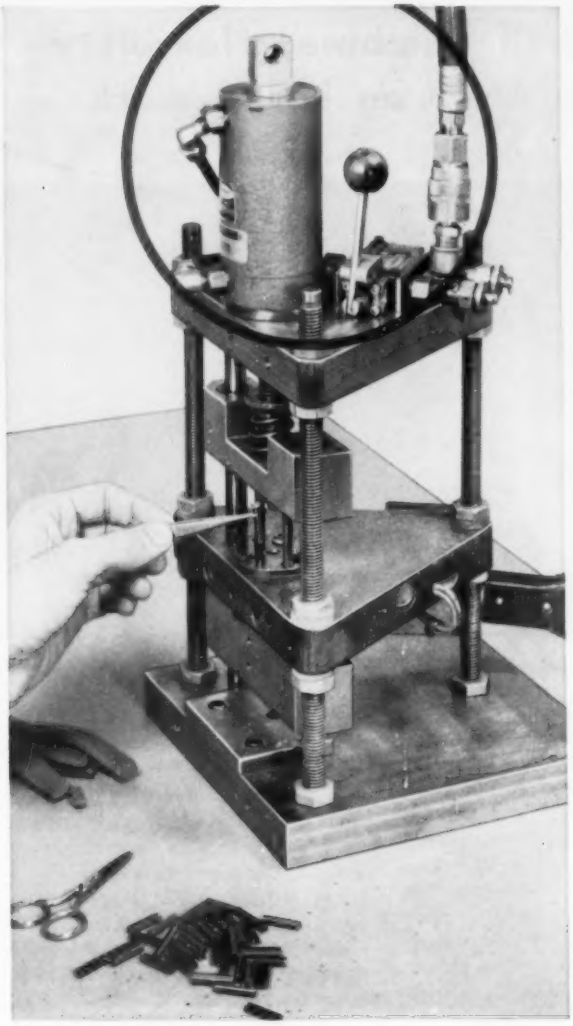
WHY WAIT FOR THE "FACTORY OF TOMORROW"?

Automate for profit now with Modernair®



ULTRONIX, INC. builds its own Modernair-powered plastics molding presses

Manufacturers of precision wire-wound resistors for the fast-moving electronics industry, ULTRONIX, INC., had to develop much of their own production equipment for their new plant at San Mateo, Calif.

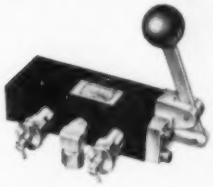
Typical is the molding press shown here which turns out a tiny plastic bobbin for their "ULTRIMMER" miniature trimming resistor.

A 2" bore double-acting Economair cylinder with 5" stroke closes the electrically heated molding die, holds it under pressure for the 45-second molding cycle, the piston then retracts to open the die and automatically eject the part. The cylinder operates at line pressure (120 to 150 psi.). Temperatures average about 350° F.

PISTON SPEED CONTROLLED IN BOTH DIRECTIONS

Operation is controlled by a 4-way Modernair CRV-410 lever-operated valve. Speed control was desired in order to close the die with a squeeze instead of a slam, and to eject the molded part gently.

This was accomplished by installing Modernair Exhaust Speed Control Valves in each exhaust port on the CRV valve (see photo).



Simplest, most economical speed control you can use! All Modernair 4-way valves have separate threaded exhaust ports for both ends of the cylinder. You can get piston speed control in either or both directions simply by installing the inexpensive Modernair Exhaust Speed Control Valves shown here. Speed is easily adjustable, "stays put" where set.

TOGGLES INCREASE PRESSURE ON LARGER PRESSES

The press shown is one of more than 20 air-operated molding presses used in the Ultronix plant. Larger presses use toggle action to multiply the force of the air piston to attain the necessary closing force on the dies. Many presses are equipped with air-operated index tables for higher production speeds.

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NEW CATALOG READY

Most comprehensive ever published in the fluid power industry, this 72-page manual is an invaluable handbook for those who want to put fluid power to work. A note on your company letterhead will bring your free copy promptly. Write today, please address Dept. H-6.

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41

SUNDSTRAND

"ENGINEERED PRODUCTION" NEWS

Universal Bed Type Rigidmil Combines Flexibility with High HP in Cutting Costs on Large Work

Machining end of work piece is illustrated in this example using all angle head in horizontal position and vertical feed.

Machining on top of the work is illustrated in this example using the All Angle head and longitudinal table feed.

All angle head is used to mill clearance cuts at an angle using transverse feed. All power feeds are infinitely variable.

Horizontal spindle and longitudinal table feed are used for face milling first surfaces of large casting.

Because this universal bed-type Rigidmil milling machine was able to machine a total of 28 surfaces on this large, heavy casting in just two setups, sizable savings were effected through a reduction in handling and setup times. Production is not sacrificed to gain flexibility as both the horizontal spindle and the all angle head have the horsepower needed for heavy cuts using carbide cutters, 50 and 20 hp respectively.

Positioning the cutter instead of the work, eliminates special fixtures needed to machine complex angles on conventional machines, and reduces set-up time. Accuracy standards invariably exceed those possible on other machines because of the reduction in workpiece handling.

Machine has a table feed stroke up to 216 inches, transverse feed stroke of 24″ and vertical feed stroke of 26″ making possible machining on large work pieces. Pushbutton pendant control of all machine speeds and movements enables the operator to keep close control over every type of job.

In addition, slab milling can be performed with the main spindle by mounting an arbor support on the dovetail ways provided. An extra cost option is a power operated draw rod for the horizontal spindle that simplifies cutter change.

AUTOMATIC LATHES | MILLING MACHINES | SPECIAL MACHINES | DRILLING MACHINES | GRINDERS

SUNDSTRAND

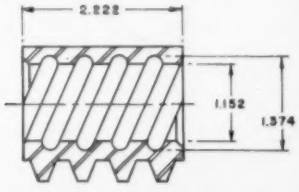
Steering Gear Part Thread-Milled in Automatic Setup

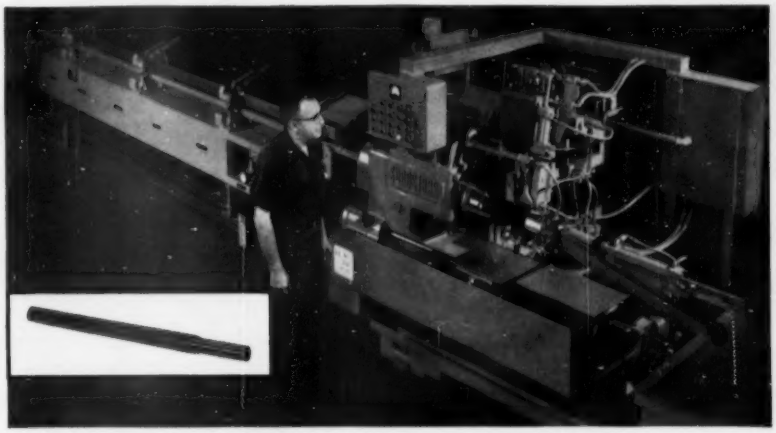
A two pass operation that leaves minimum stock to be removed in a following finish-grinding operation is used to produce approximately 72 ball nut components for automotive steering gears per hour on this Sundstrand Hanson-Whitney thread milling machine. Material is SAE 5120 steel.

Because of the limiting physical dimensions of the cutter (small diameter in relation to length) a rough cut and finish cut are made to hold stock to a minimum for final grinding operations. Both rough and finish cuts are in one automatic cycle.

The completely automatic cycle, including load and unload, permits the operation to be handled with minimum operator skills and allows one operator to handle several machines.

Hanson-Whitney 10 x 24 inch machine built by Sundstrand equipped for automatic production, including load and unload, of automotive component. Principal dimensions of ball nut unit are shown below.





Hopper-Fed Sundstrand Lathe Turns 450 Shafts Per Hour

A special hopper arrangement for automatic feeding of bar stock to permit continuous cycling helps this Model 6A Sundstrand Lathe set a fast production pace. Fractional horsepower motor shafts are turned at an average rate of 450 per hour with lengths of finished shafts ranging from 9 to 13 inches.

Bar stock is fed automatically thru the spindle; is cut to length, turned, and grooved; and is automatically ejected onto the conveyor at the completion of the machine cycle. Front, rear, and overhead tools are provided to reduce machining time. Because production requirements change frequently, quick setup tooling using micrometer tool blocks and stops is used. Not only does this permit reduced change-over time but it also eliminates the need for trial cuts at the start of a new production run.

Ceramic Tooling Keeps Brake Drum Output High

Combining ceramic tooling with the modern design features of the Sundstrand vertical lathe has opened the way to new highs in production efficiency on this brake drum turning operation. Hourly production is now at 72 units per hour at 80% efficiency, at nearly double the surface speed used with carbides. Surface finishes exceed any previously attained, eliminating the need for a sanding operation formerly required.

Easy loading and unloading made possible by the vertical lathe design play an important role in the increased production rate. Open front vertical machine makes it easy to provide automatic chip disposal, an important advantage in view of the high rate of metal removal.

Learn more about how Sundstrand "Engineered Production" can solve your machining problems by writing for Bulletin 704 today.

BROACHING TOOLS BROACHING MACHINES PRESSES

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MACHINE TOOL
Div. of SUNDSTRAND CORPORATION
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Allen Hughes

cut abrasive costs 18 to 1 at

Grinding the gripper-die marks off a jet turbine blade can be an expensive business. At the Harrisburg Works of Thompson Ramo Wooldridge, these super-alloy steel blades used to be semi-finished with coated abrasive belts until Industrial and Abrasive Control Engineer Paul Mazich started checking up on costs.

Mazich called in Bay State Abrasive Engineer Allen B. Hughes and he dug into the problem. Working with Bay State distributor General Machinery & Equipment Company, Hughes made a series of careful tests. The result was a grinding wheel that cut the annual cost of abrasive materials alone from $18,000 to $1,000. Its unique combination of special bond and abrasive grit increased cutting speed, prevented loading and eliminated the need for dressing so successfully that productivity rose, labor costs dropped and there were additional savings of around $5,000.

Like Allen Hughes, the Bay State Abrasive Engineer in your area is a trained expert. He backs up the work of the experienced men who represent Bay State's topflight distributors and Bay State's research labs back them both with new ideas, techniques and materials. *Better grinding at lower cost . . . that is our business.*

Industrial Engineer Paul Mazich examines finish on jet engine blade forging after off-hand grinding operation illustrated at right.

Operator E. S. Jones semi-finishes jet turbine blade in off-hand grinding operation with cool-cutting, self-dressing Bay State grinding wheel.

Thompson Ramo Wooldridge

Allen B. Hughes worked up through Bay State's Westboro plant and then added extensive field experience so that his knowledge of abrasive problems and practical solutions for them covers every phase of abrasive engineering.

BAY STATE ABRASIVES

BAY STATE WHEELS of PROGRESS

Bay State Abrasive Products Co., Westboro, Massachusetts.
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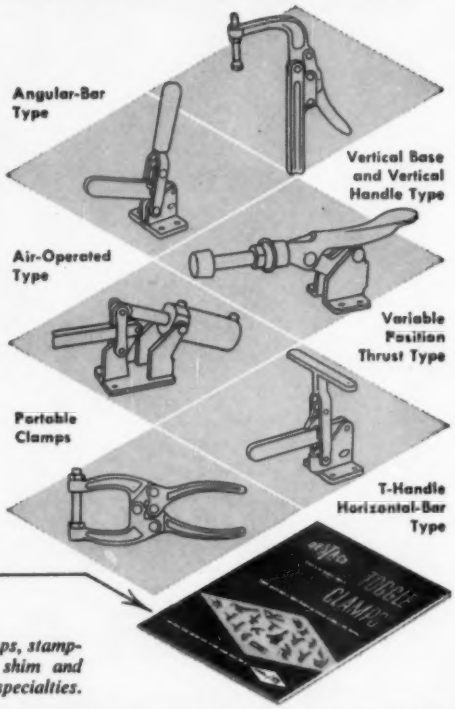
Where It's Quality, Quality, Quality!
It's Quality DE-STA-CO Toggle Clamps

FINAL INSPECTION OF ROSS OPERATING VALVES subjects every valve to a pressure test far exceeding its normal usage. For over fifteen years, fixtures similar to this, all employing De-Sta-Co No. 620 plunger clamps, have been built to do this critical high pressure sealing job.

Whether your holding and clamping operation is inspection, machining, tapping, grinding, welding, bonding or other assembly, there is a specific De-Sta-Co Toggle Clamp to do it better. Fast action, positive clamping, long life through thousands of production operations have made De-Sta-Co known for almost 30 years as the leading tool in the field. And all of our medium and larger models use hardened serrated pins in hardened bushings staked to prevent wear. A broad selection of spindle accessories increases the versatility of the clamp you specify.

Our representative in your area is qualified and ready to serve you. Send for our catalog showing clamp applications, scale drawings and complete information.



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De-Sta-Co is widely known for toggle clamps, stampings, precision washers, spacers, shims, shim and feeler stock, blower housings and marine specialties.

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ECCENTRICITY 0.0002" maximum
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MATTISON
HIGH-POWERED PRECISION
GRINDING METHODS

Chipless machining brings 3-way cost reduction at Ingersoll

Electrolytic grinding slashes cost of finishing brazed carbide tools

If you have tough, hard, or heat-sensitive materials to machine, look at how The Ingersoll Milling Machine Company, Rockford, Illinois, reduced machining costs 18% . . . slashed abrasive costs 80% . . . and made a reduction in scrap losses with a highly controlled application of electrolytic grinding.

The headache at Ingersoll's Cutter Division was in grinding the faces of brazed carbide-tipped milling cutter blades. On a horizontal spindle grinder, unit pressures were so high in order to penetrate the carbide, the wheel had a tendency to gouge into the soft shank steel. It was difficult to stop wheel-loading, heat-checking, and cracking—not good because almost 80% of the blade cost was lost in scrap occurring at this stage.

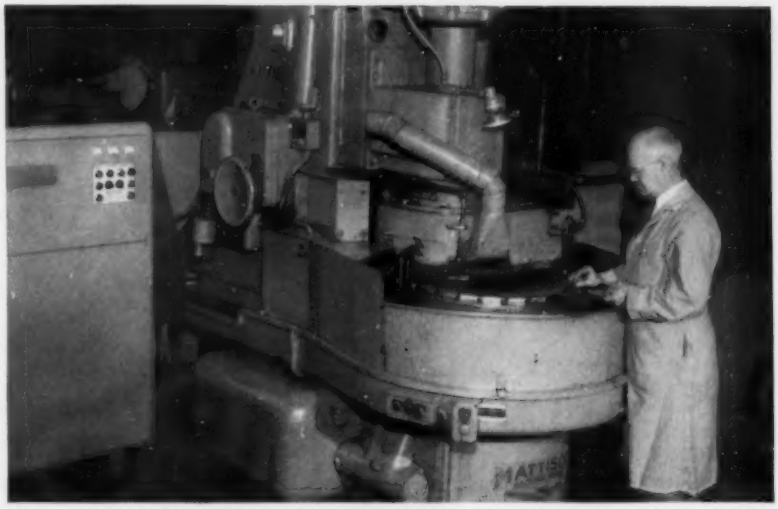


Fig. 1—Single-pass electrolytic grinding, with carbide removal averaging .005 to .008 in., is a more efficient method of finishing the faces of carbide-tipped milling cutter blades. Downtime for cleaning and loading the table is eliminated.

First continuous electrolytic process

The profit-significant features of this machine are:

1) continuous, single-pass machining.
2) high stock removal.

This is really the first application of electrolytic grinding to a machine that does not require batch-type loading and multiple-pass stock removal.

With the magnetic chuck slowed down to 12 revolutions per hour, the operator just loads the blades at one side of the table and picks off the finished blades from the other. Pie-shaped magnetic sections are energized automatically as the work passes under the wheel and are de-energized as it emerges on the other side. No machine adjustments are required until a new lot of different sized blades is to be ground—all nonproductive time for cleaning and loading the table has been eliminated.

Blades come directly from tip-brazing to the Mattison. With carbide removal averaging .005" to .008" per pass, the 1500-ampere electrolytic grinder finishes them to size in one pass, holding finish within 20 microinches, rms.

Since metal removal is now virtually a "scrubbing process," there's no danger of heat-checking or cracking. At the present rate of wear, using a 100-grit, 100-concentration diamond wheel with 1/16" depth of diamond, wheel cost per blade is 80% lower than it was on the horizontal.

If your problem is heat damage, high wheel costs, distortion of thin sections, difficult machining of carbides, or finding a suitable process for cutting tough super alloys, let Mattison evaluate the new economics of "chipless machining." It may be the solution you're looking for.

Fig. 2—Finished blades (left) have a surface finish of less than 20 microinches, rms. Tests at Ingersoll prove there's no difference in break strength or blade life when the electrolytic process is used.

Free Methods Study

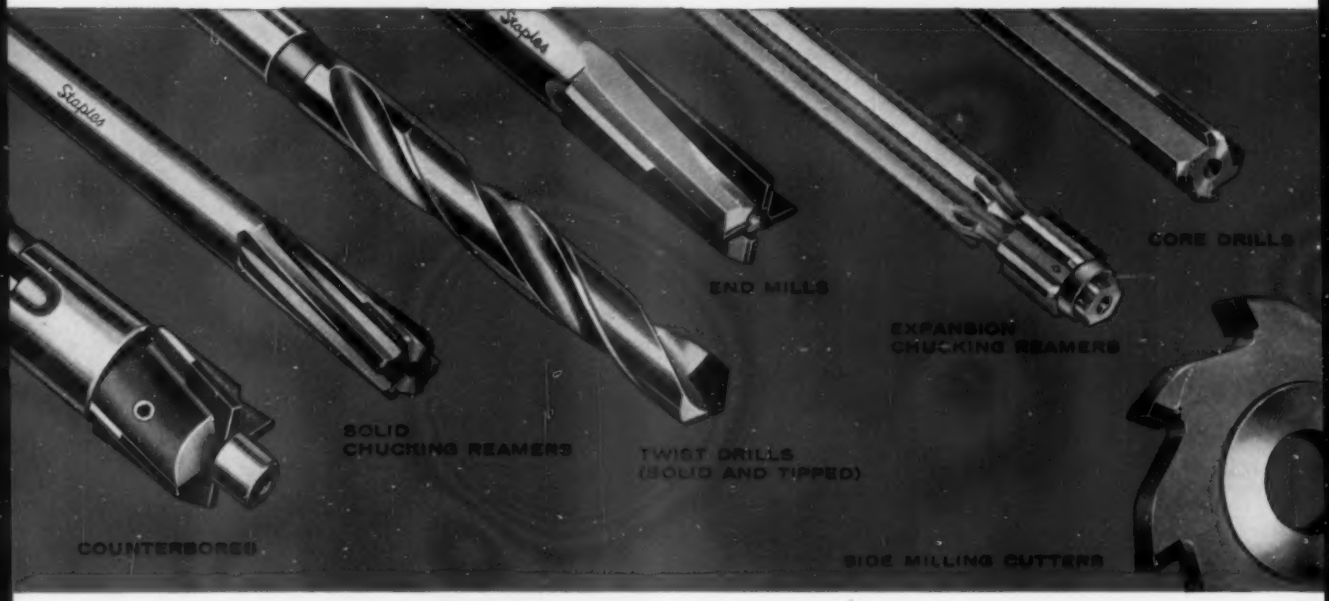
You can inspect, first hand, the value of Mattison's new Quick-Tilt surface grinder for machining your own workpieces. Production tests show that the average grinding operation can be at least 50% more efficient with this new method. We will machine your parts in our Methods Laboratory and give you a complete job analysis which takes the guess out of grinding. There's no obligation—your Mattison dealer will make all the arrangements.

MATTISON MACHINE WORKS
Rockford, Illinois WOodland 2-5521

MATTISON
HIGH-POWERED PRECISION SURFACE GRINDERS

USE READER SERVICE CARD; INDICATE A-6-65

How to tell which carbide tool will give you the most production



When you see the name Staples on any carbide-tipped or solid carbide tool, you may be sure that you have purchased a cutting tool specifically designed for high production potential.

For behind this name is over twenty years experience in manufacturing accurate and economical cutting tools. Tools that meet the demand of today's higher speeds and feeds.

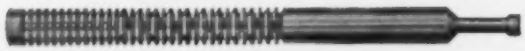
Service is another thing you will like about dealing with Staples. Example: Upon request – in just 48 hours – we will ship stock carbide reamers and core drills ground to your specified diameters. And you will receive prompt quotations on "special" carbide tools made to your specifications by skilled Staples craftsmen.

Staples
ROTATING CARBIDE TOOLS

THE Staples TOOL COMPANY
2352 GLENDALE-MILFORD ROAD, CINCINNATI 15, OHIO

NEW CP PORTABLE BROACH GUN CONVERTS ROUND PILOT HOLES TO SHAPES

You take the tool to the work with the CP Portable Broach Gun . . . a completely new technique in broaching. Operation is fast and simple. Broach is inserted in pilot hole and with a squeeze of the trigger the hole is formed or finished in a single, swift operation. Set-up time is eliminated since no jigs, fixtures or templates are required in most applications. Drilled, punched or cast holes can be finished to round, square, hexagon, oval, or irregular shapes in any work area. Angle Broach Puller, for close quarters, is also available.



The broach pulls a clean hole every time, and leaves it "mirror" finished. Hole sizing accuracy can be ±.0002. Unskilled operators can consistently produce accurate holes with minimum training time.

CP Power Cell weighs only 58 pounds, operates on shop air lines, furnishes oil pressure up to 7,000 psi. Easily moved from job to job anywhere in the plant. Also powers hydraulic riveters, squeezers, punches.

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hex

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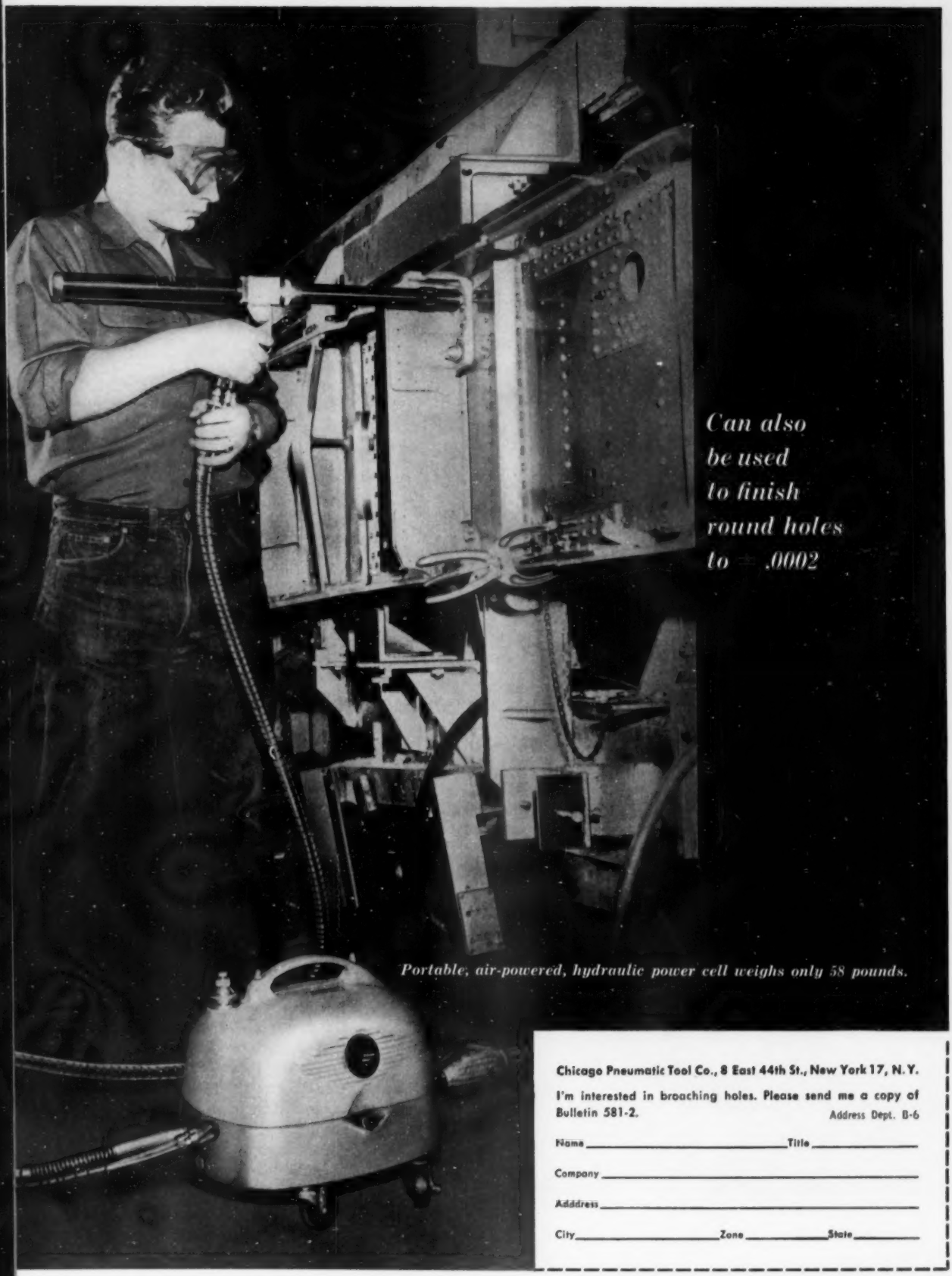

Can also be used to finish round holes to .0002

Portable, air-powered, hydraulic power cell weighs only 58 pounds.

Chicago Pneumatic Tool Co., 8 East 44th St., New York 17, N.Y.

I'm interested in broaching holes. Please send me a copy of Bulletin 581-2. Address Dept. B-6

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Mill Odd Shapes

...with Barber-Colman Form-Relieved Cutters

We don't expect you to have a job exactly like this . . .

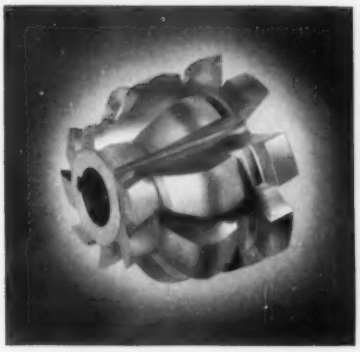
. . . but the manner in which cutter design was established may illustrate important benefits gained by submitting part prints to the Barber-Colman Tooling Service.

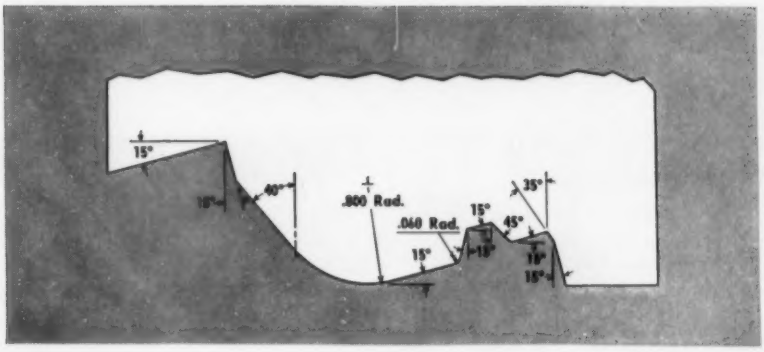
Whether you have irregular forms or a combination of straight surfaces to machine, a comprehensive engineering analysis will help you determine the one best cutter for increasing accuracy and combining operations economically.

Electronic computer aids cutter design

This cutter requires a 10° helix and a 10° positive radial rake to produce the accuracy and smooth finish on the part. The helical flutes and radial rake make it necessary to calculate the cutter tooth form which will produce the desired part form. All plot points, formerly obtained manually, were determined rapidly and accurately on a Bendix computer. Only the points where a change in form

in One Operation





occurs were obtained manually. Over 60 other points were determined quickly by the computer.

An electronic computer has the following advantages for you:

1. *Accurate cutters* — A direct solution is possible through the application of mathematical formulas which eliminate trial-and-error solutions. The great number of plot points which can be determined quickly and accurately assures exact duplication of complex shapes.
2. *Economical design* — You get the highest possible number of engineering man-hours devoted to actual development of the cutter because fewer hours are required to work out details.
3. *Faster service* — Speed of computation permits us to check a number of designs and still meet reasonable delivery schedules.
4. *Flexibility to change* — All variables other than form, such as helix angle, side clearance, number of teeth, cam, diameter, rake, etc., can be changed at any stage of engineering without rigidity at our end. There's no incentive to "save" a design should a different helix angle or diameter be desired.

Design of this cutter included a cutting clearance problem. If the part were set square with the cutter, a two-piece cutter with axial relief in both directions would be required. However, by tipping the part at 15°, a one-piece cutter can be used.

Let us analyze your milling operations

The Barber-Colman Tooling Service is the most complete milling cutter facility available under one roof. Your part drawing can be evaluated in terms of every cutter style, for which we have complete manufacturing facilities: (1) standard or special cutters, or a combination of these in a gang; (2) high-speed steel or carbide-tipped; (3) eccentric-relieved or profile-type; and (4) ground or unground form.

There is a lot of wisdom in re-checking operations periodically in terms of new tooling and methods. This is not a difficult or costly thing to do. Yet it may reveal golden opportunities to tighten up tolerances, improve surface finish, or reduce manufacturing costs. It may be on a time-consuming planer job, a series of flat-surface milling operations, complex form milling, or even new pieceparts.

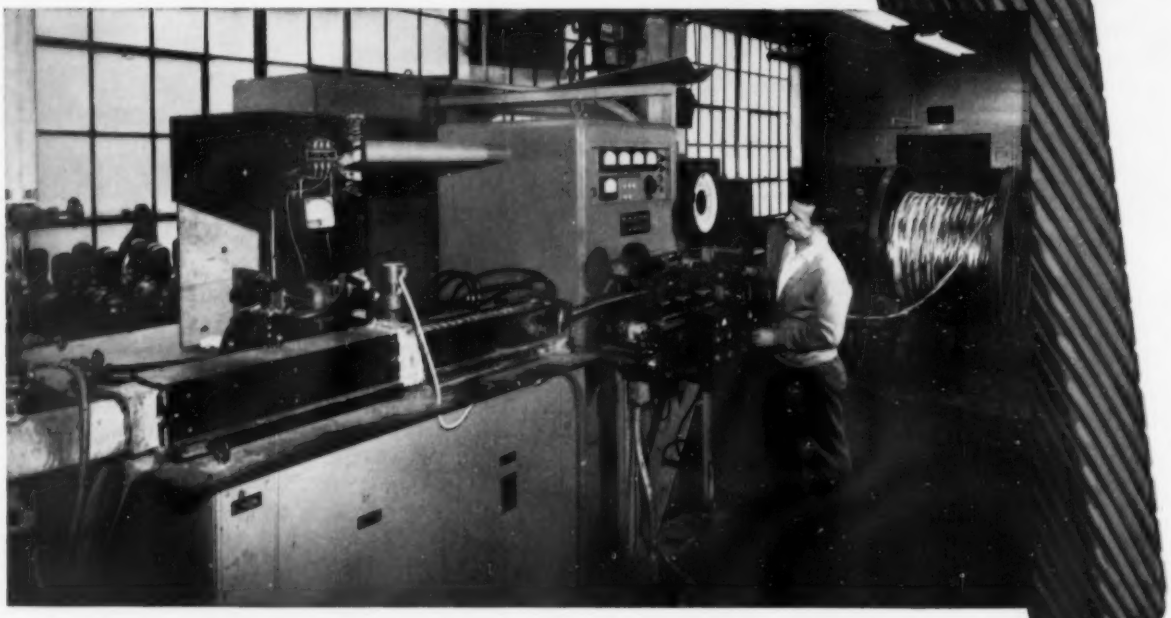
How about putting the Barber-Colman Tooling Service to the test? It will cost nothing to submit part prints or discuss your jobs personally with a Tooling Specialist. We're ready any time you are. Call your nearest Barber-Colman field office or the factory — TR 7-5741.

Barber-Colman Company

BARBER COLMAN

63 Loomis Street, Rockford, Illinois

How TOCCO* Induction Annealing makes copper cable easier to handle in the field . . .



A world famous manufacturer of quality cable now treats its customers to the best with TOCCO-annealed cable that's easier to reel off, easier to splice and generally easier to handle in the field. Cable segments pass continuously through a TOCCO inductor coil at the rate of 23 feet per minute for the 800 mcm material illustrated. Many sizes of cable segments, up to one million circular mils, are annealed on one TOCCO unit.

TOCCO's many advantages over conventional annealing methods include:

1. TOCCO provides "bright annealing"—no discoloration.
2. TOCCO requires just a fraction of the space of conventional bell-type furnaces.
3. TOCCO's output is nearly four times that obtained by conventional annealing methods.
4. TOCCO equipment requires one operator as opposed to three required for the bell-type furnace operation.

Whether your products involve ferrous or nonferrous materials, look to TOCCO for an economical solution to your metal heating problems—annealing, brazing, hardening, melting or heating for forming or forging operations.

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YOU

YOU are a tool engineer, born with a mechanical aptitude and an interest in the practical problems of manufacturing.

YOU were not, however, born with a mechanical attitude. This quality must be developed.

YOU belong to a Society which provides continuous service to your chosen profession.

YOU have again selected a board of directors, national officers and committees which, teamed with chapter officers and headquarters staff, are dedicated to advancing the capabilities of tool engineers.

YOU should contribute to your profession and help the Society which represents that profession as it turns long-range plans into realities.

YOU are aware that competition from other countries is beginning to affect the production and profit of our industries.

YOU are aware that as profit is affected so also will be your pocketbook.

YOU are individually responsible for a portion of the technological progress of your company.

YOU must increase your initiative to absorb the technical developments and improvements, together with modern manufacturing procedures, as they are developed by tool engineers.

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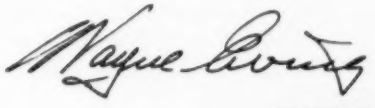

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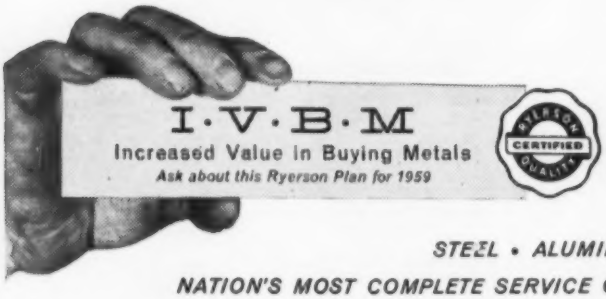

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MEASUREMENT ERROR
detection and correction

By William J. Hill, Manager
Statistical Service Sect., Quality Control Div.
Ford Instrument Co., Long Island City, N. Y.

Many of the components in a guidance or control system must be manufactured within tolerances of fifty millionths inch. The exact inspection problems are compounded when material supplied by outside sources must meet these rigid requirements but are measured on different equipment. This article discusses some of these problems and what has been done to solve them.

STRINGENT RELIABILITY REQUIREMENTS demand close manufacturing tolerances on both assemblies and component parts. To assure that these tolerances are met, the best measuring equipment available must be used. Strict control over its use must be exercised by having the equipment periodically recalibrated and by restricting its use to operation by adequately trained personnel, *Fig.* 1.

The question arises, however, if the basic program of equipment and personnel control really gives the protection necessary. To ascertain the effectiveness of this type of control program, the following questions can be asked:

1. What is the precision or repeatability of the measuring equipment in use?
2. Do different operators using the same measuring equipment obtain the same readings?
3. How many of the disagreements between in-process and final inspection, between incoming and supplier's final inspection, and between final inspection and purchaser's inspection are the result of poor repeatability or correlation of equipment?

In actual practice, 100 percent inspection is not 100 percent efficient. Measuring equipment graduated in ten-thousandths of an inch, often is incapable of repeating within one graduation. In addition, readings taken on the same part with two "identical" measuring machines often differ by more than one graduation. Therefore, along with a basic control program, a manufacturing organization must conduct continuing studies of the correlation and repeatability of measuring equipment which they and suppliers use. Also, suitable inspection programs must be devised which will insure that tolerances will be held should the repeatability of measuring equipment be poor and cannot be improved by adjustment or recalibration.

Gyro Bearings

Shop-produced components and purchased components of a gyro assembly did not go together properly because of the differences in measuring equipment and operating personnel at the two sources of manufacture even though each was maintaining tolerances within its own operations, *Fig.* 2. The supplier of purchased material was required to grade bearings for both inside and outside diameter into four classes— *A*, *B*, *C* and *D*—for each dimension. Each class had a 50-millionths-inch spread in dimension and each bearing was identified with two letters: *AA*, *AD*, *BC* and so on. At assembly of the gyro, the bearings were matched by their code letter to shop-manufactured parts. This matching was necessary as tolerance on each part was two ten-thousandths and tolerance on fit was one ten-thousandth. In practice parts which went together on paper did not on the assembly bench. When shop-supplied parts were reinspected, the same measure-

ments were obtained as before. However, bearings labeled *AA* were found to be *BA, AB* or *BB.*

The outside source of supply graded each bearing, put it in a heat-sealed bag in a box marked with the grade. Previously, the incoming inspection department made only a visual check to assure that the right part was received. Now to check grading each bag had to be opened, the bearing measured, cleaned and relubricated, and repacked in another heat-sealed bag. Still another problem arose—the frequency distribution of bearings from inspection was not the same as from the supplier. This meant that frequently supply of a particular bearing grade needed for assembly was not sufficient.

Approach to this problem was to determine the repeatability of both shop and supplier measuring equipment, the average difference in measurement between them, and a correction factor which would enable the supplier to correctly grade readings to shop measurements. A nested factorial experiment was designed to enable measurement differences to be properly assigned to the following:

1. Different measuring machines used
2. Different setting rings used
3. Different operators (two from the supplier and two from shop).

Four different size bearings were used, one for each class. It was assumed that a significant difference would be found between them. If no significant difference were found, there would be no sense to grading. To determine precision of the measurements, it was necessary to include a repeatability study in the experiment. In the repeatability study each test condition was repeated at random times during the course of the experiment. This gave two complete sets of data for the experiment. Analysis of the difference between these two sets of data allowed determination of repeatability. The results of this experiment for the inside diameter measurements are shown in *Fig.* 3.

Similar data were obtained for the outside diameter measurements. The analysis for both sets of data was performed in the same manner. There are two steps involved in this analysis: determining the repeatability of measurements and determining significant causes of measurement difference.

Determining Repeatability: Repeatability was determined by taking the difference or range between measurements obtained under identical conditions. Since the experiment was repeated twice, one range for each test condition was obtained by taking the difference between the two sets of measurements. The average range over-all measurements constituted an estimate of repeatability.

Formal statistical technique assumes that the repeatability is relatively constant throughout an experiment. In this case, however, this assumption was verified by using the control chart technique—one from which it can be determined whether successive samples from a process fall within limits

Fig. 1. Engineer performing shock test on a guided missile component.

Fig. 2. Engineer checking the diameter of a precision bearing on an air gage. These components used in the guidance system of a missile are checked and properly graded for both inside and outside diameter.

Machine		Shop gage A				Supplier gage B			
Setting ring		Ford		Supplier		Ford		Supplier	
Operator		F_1	F_2	F_1	F_2	S_1	S_2	S_1	S_2
Bearing	A	5	0	10	10	30	20	20	20
		0	10	0	5	15	40	35	30
	B	50	50	50	60	70	60	60	60
		40	60	50	65	50	80	75	45
	C	100	95	100	100	115	110	95	115
		95	100	110	90	95	95	115	100
	D	150	145	155	155	165	155	165	155
		140	145	160	150	180	165	150	180

Fig. 3. Bearing inside diameter measurements (coded). This data forms the basis for determination of repeatability of the measuring equipment.

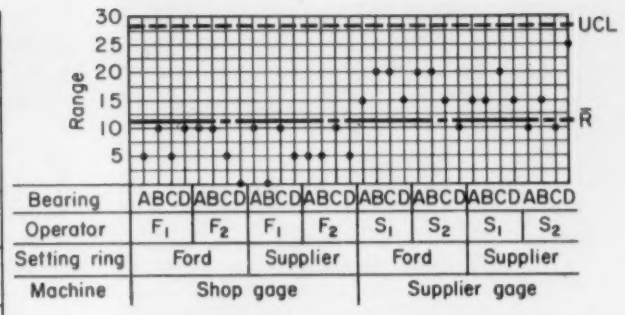


Fig. 4. Control chart for ranges. All points plotted are within the accepted control limits.

based on the history of the process. Statistical technique revealed that 95 percent of the individual ranges should fall in the interval from 0 to 2.48 $\bar{R}$, where $\bar{R}$ is average range. For the values shown in *Fig.* 3 the interval is 0 to 28.8. The ranges were plotted on a control chart, *Fig.* 4. This chart showed that all the points were within the control limits. However, repeatability of the first sixteen points appeared to be much better than the repeatability of the second sixteen points. The first sixteen points showed the repeatability of the shop machine and the last sixteen points showed the repeatability of the supplier's measuring machine. When the average repeatabilities of the machines were compared, by a variance ratio test, a significant difference in repeatability was found. There was no significant difference in repeatability between the two shop operators or the two supplier operators. Operator 1 was equivalent to operator 2 in both cases. Based on this variance ratio test, it was concluded that the supplier repeatability must improve if bearings were to be graded properly. This is true, of course, only if no other differences exist between the measurements made in the shop and those made by the supplier.

Significant Causes of Differences: To determine whether significantly different measurements were obtained from the different measuring equipment, different operators or different setting rings, the average value of the measurements was compared under each condition to the average measurement for the experiment by the use of a control chart. In order to do this, two-way tables for each pair of variables were set up. All of the possible pairs of variables and data for each pair were grouped to show only the effects of these two variables. The two-way tables for the three possible combinations of variables are shown in *Fig.* 5. The operator effect is not shown in any two-way table since it is a nested effect and therefore it is only important to determine whether operator 1 differed from operator 2 at the shop or whether operator 1 differed from operator 2 at the supplier. Each number shown in the two-way table is an average measurement. The grand average is calculated from the values of these subaverages.

The extent of random variation of the average measurement from the over-all average should be within limits calculated as follows:

$$U = \bar{X} + \frac{t_a \bar{R}}{1.128\sqrt{n}}$$

$$L = \bar{X} - \frac{t_a \bar{R}}{1.128\sqrt{n}}$$

Bearing	Machine		
	Shop	Supplier	Avg
A	5.0	26.3	15.6
B	53.1	62.5	57.8
C	98.8	105.0	101.9
D	150.0	164.4	157.2
Avg	76.7	89.5	83.1

Ring	Machine		
	Shop	Supplier	Avg
F	74.1	90.3	82.2
S	79.4	88.8	84.1
Avg	76.7	89.5	83.1

Bearing	Ring		
	Shop	Supplier	Avg
A	15.0	16.3	15.6
B	57.5	58.1	57.8
C	100.6	103.1	101.9
D	155.6	158.8	157.2
Avg	82.2	84.1	83.1

Fig. 5. Two-way tables for determination of average measurements.

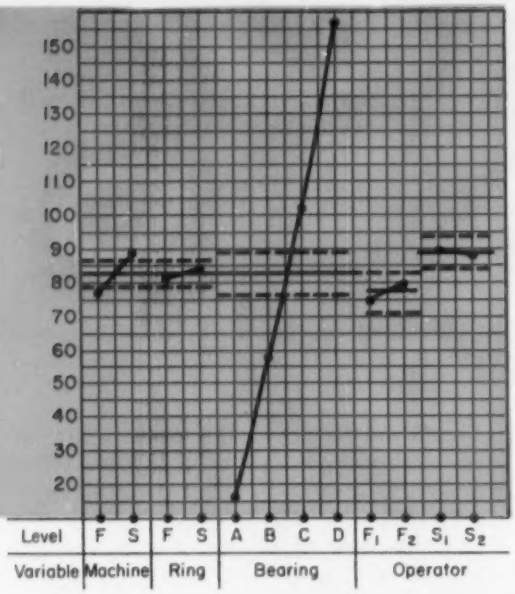


Fig. 6. Control chart for main effects. This chart shows that the effects of measuring machines and bearings are significant.

Where U is upper control limit, or UCL, L is the lower control limit, or LCL. $\bar{X}$ is the grand average in *Fig.* 3, t_a is Student's "t" $\bar{R}$ is the average repeatability over-all the measurements, and n is the number of readings used to obtain the average measurement for a level of the input variable. Tables are t_a are available in most statistical texts. For the data shown there were two sets of limits, one set for the variables with two levels (machine setting rings) and one set for the variables with four levels (bearings, operators). By putting these control limits on the chart a control chart was obtained for main effects, *Fig.* 6. A common grand average was used for determining the upper and lower control limits for the machine setting ring, and bearing effects. However, since the operator effect was nested within the machine effect, operator 1 against operator 2 was compared for both the shop and the supplier by using the average reading obtained at each respectively. The control limits around these averages are the same distance from the average as the control limits around the bearing effect shown in *Fig.* 4.

If a point falls outside the control limits, it indicates that the effect of different levels of that variable can not be attributed to experimental error (repeatability). This effect is then significant. On the other hand, if no point falls outside the control limits, the difference in levels of that variable is due to experimental error, (repeatability) and the effect of that variable is not significant. *Fig.* 6 shows that the effects of the machine and bearing are significant. No interactions were significant.

Recommendations: Two methods to improve grading procedure were recommended to the supplier. Either the same type of measuring equipment should be used as that used in the shop, or the basic difference between shop measurements could be subtracted from his measurements before grading the bearings. In addition, it was recommended that the supplier use the average of two measurements for those bearings whose initial measurement was within twenty millionths of the grading tolerance.

Resolvers

Many computers perform trigonometric operations. The best method of generating trigonometric functions for these operations is by the use of electromagnetic resolvers. A resolver is an electromechanical device (transducer) which translates a mechanical input angle into an output voltage that is equal to the sine or cosine of the input angle. Resolvers may have one output (sine) or two outputs (sine or cosine). By series or parallel arrangement of the resolvers, any trigonometric function can be obtained in such an analog computer.

Resolvers can be divided into two general classes for test purposes. Single output resolvers are tested for accuracy or conformance to a sine function. Double output resolvers require testing for rotor and stator axis misalignment in addition to accuracy for both sine and cosine windings. If the resolver fails to meet the axis alignment requirement, it can be used as a single output resolver provided the accuracy requirement is met.

Resolvers are checked for axis misalignment and accuracy in the following manner: The resolver is placed in an angular positioning device and one winding of the stator is shorted out. Electrical zero is located, then the rotor is rotated 90 deg and the theoretical output (180 deg out of phase) is put into the network box. The rotor is rotated until a null (minimum) voltage is obtained on the meter. The angular error at this position is the rotor axis misalignment and the voltage is the noise. Stator axis misalignment is tested in a similar manner.

To test for accuracy, the rotor is positioned at an angle ϕ the theoretical voltage (180 deg out of phase) is put into the network box, and the difference between the theoretical voltage and resolver output voltage is read. This difference is the accuracy for the angle ϕ and the function.

Three different types of angular positioning devices and two different types of meters are used for testing resolvers. This gives six possible combinations of equipment that could be used to check a resolver for both axis misalignment and accuracy. The following facts were observed.

1. When a resolver was tested for accuracy, if the accuracy was borderline it was frequently retested on another setup. Resolvers that were borderline but

acceptable on the first setup were frequently borderline but unacceptable on the second setup. The reverse also occurred.

2. Resolvers which were sent back for rework would frequently fail when resubmitted to the accuracy test.
3. The rejection rate from government inspection had increased—especially since the introduction of a two-minute axis misalignment requirement on resolvers.

Since operators had been tested at an earlier date and it was found that there was no significant difference between their techniques or in their ability to test electrical components, operator difference was not considered in this study. Operator proficiency was further substantiated by examination of the failure rates for the different operators.

A repeatability analysis on the basic combinations of test equipments used in the resolver test area was undertaken. In this study four resolvers were used and repeatability measurements were taken on each resolver for each test setup. The results of this study are shown in *Fig.* 7. To analyze these results a simple range chart was used. Upon review of this chart it was obvious that there was a marked difference in the repeatability of the various combinations of measuring equipment. By replotting control limits based upon the best repeatability, most of the other combinations exceeded the upper control limits. Further analysis showed that there was no significant difference between the accuracy of the different setups.

Applying Results: There was no significant difference in repeatability between the devices on which voltage was measured. However, there was a significant lack of repeatability among the different positioning devices. The best average repeatability was that of one device which had an average repeatability of 0.7 minute of arc. The remaining two had an average repeatability of 1.9 minutes. Since even the best test setup had an average repeatability that used up one-third of the tolerance, it was necessary to take the following measures to increase the production of acceptable resolvers. The first device was to be used only for testing resolvers with two and three minute axis misalignment requirements. The other angular positioning devices were to be used only on resolvers with five minute axis misalignment requirements. As lack of repeatability used up much of the tolerance, the following alternatives were available: 200 or 300 percent test could be used; specification limits could be tightened; better equipment could be obtained; or some form of selective double testing could be utilized. Obviously the first alternative was to be avoided if possible since it would double or triple the test time. The second would also raise the cost of producing resolvers and was not solving the real problem. At the time this study was made the most economical equipment available was in use. More precise equipment was available but it was too slow for production jobs. Therefore, the last is the only practical solution—since it required retesting on borderline units but not on units that were obviously acceptable or rejectable. The test procedure was rewritten and all readings that were within one sigma of the specifications limits were to be retested at a later date (usually the next day). If both readings were within specification limits, the resolver was considered acceptable. Any reading outside of the specification limits would be cause for the rejection of the resolver. These new procedures appreciably increased protection and production.

Meter		Phase			VTVM		
Positioning device		θ	GT	DH	θ	GT	DH
Resolver	1	0 -3	0 -4	-4 0	-1 -3	+1 -5	-5 +8
	2	+1 0	-2 +3	+5 -4	-2 +2	+5 -3	-4 +3
	3	-3 -8	+2 -11	-2 -9	-5 -3	0 -12	-2 -10
	4	+2 +4	-1 +9	+9 -2	+1 +4	+2 +6	+4 +2

Fig. 7. Rotor axis misalignment data. Values are in ¼ minute of arc.

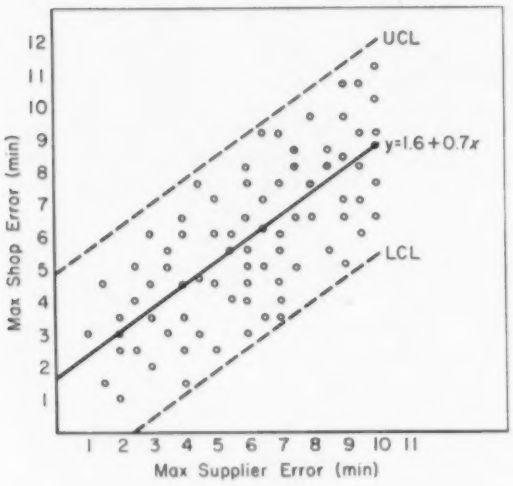
Synchros

Many engineering specifications require the supplier to furnish test results with each shipment of components. Whenever these data are received with the component an opportunity is presented to reduce the amount of testing on the lot while still maintaining desired incoming quality level. Testing synchros is an example of such an opportunity, *Fig.* 8. A synchro is an electromagnetic device which relates a mechanical input into an output voltage proportional to the input angle. Four types of synchros are purchased: transmitters, receivers, control transformers and differentials. The test procedures for transmitters, control transformers and transmitter type differentials are the same and use the same equipment as the resolver test plus a bridge to balance the three-phase synchro output. The test for a receiver or a receiver-type differential requires in addition, a master transmitter to generate a signal for the receiver. A synchro is tested by rotating until a minimum voltage output is obtained, then the angular error on the positioning device is read. Suppliers furnished accuracy data either in the form of brush recordings of synchro error or measurements taken every 15 deg.

If the suppliers measurements correlated with

Fig. 8. Semiautomatic accuracy tests being performed on a synchro control transformer. The specifications for this component call for an accuracy of ±7 minutes, however a ±5-minute accuracy usually is held.

Fig. 9. Synchro error scatter diagram.



those of the shop, a tremendous amount of test time on each lot could be saved. Incoming test data were reviewed and it was found that the best measure for correlation purposes was maximum angular error. A scatter diagram, *Fig.* 9, shows the relationship between the supplier's measurements and the incoming inspection measurements. The regression equation and confidence limits of *Fig.* 9 were obtained by using the forward Doolittle technique. Intersection of the upper 95 percent confidence limit with the ten-minute error line was selected as the cutoff point.

Incoming test procedure was rewritten as follows: All supplier data are reviewed and all those synchros that show a maximum error of 7.5 minutes or more are tested. In addition, five synchros with errors less than 7.5 minutes each are selected for test. Results are forwarded to the statistical services section. The statistical services section reviews the results of each sample. If the correlation is good, the lot is accepted. If the correlation is poor, the synchros are progressively screened to tighter maximum error limits. So far excellent correlation with suppliers has been obtained.

The extension of this technique to other supplier components and to parts manufactured by the shop has resulted in savings of up to 90 percent in test and inspection time with no deterioration in the level of product quality.

Summary

Correlation and repeatability are inherent problems associated with measuring equipments. There exist techniques that permit determination of the correlation and repeatability of measuring equipment. However it is not enough to realize that these problems exist. Obviously if better equipment is available and is justified by economics it should be procured. When it is either not available or not justified, alternative measures that will maintain product tolerances must be used. The most promising method to use in the borderline area caused by poor repeatability and close tolerances is selective double inspection. This will guarantee the maximum protection against the acceptance of substandard material for a minimum amount of inspection time and effort.

The problems cited are but a sample of those that have been solved by the use of elementary statistical techniques. An additional area that holds much promise is error analysis. This is simply the determination of the basic error pattern of an item. In the resolver study it was found that only 18 of the 72 test points called for in the test specification needed to be checked because these were the only points that had exhibited errors likely to cause rejection. Applying selective double inspection to 18 points instead of the original 72 gives the maximum possible protection for a test dollar.

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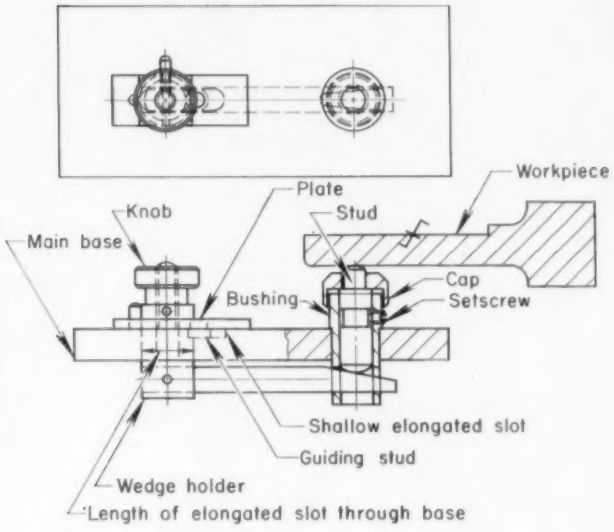
Gadgets

Ingenious Devices And Ideas To Help
The Tool Engineer In His Daily Work

Adjustable Support

Supporting rough, irregular castings for milling or profiling operations is something of a problem when fixed-height supports or shims are used. The support illustrated is adaptable to many workpiece configurations and is easily adjustable.



A stud that rides up and down in a bushing supports the workpiece. The bushing is at one end of a base plate. At the other end of the base plate is a knurled knob that screws onto threads on a wedge holder. A wedge, projecting from the wedge holder, fits into slots in the lower portion of the bushing and bears against the stud.

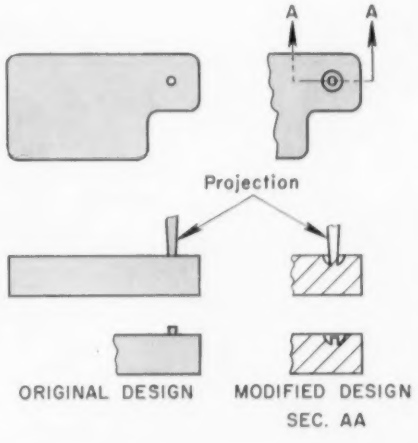
The knob-wedge holder assembly rides in an elongated slot in the base plate. This movement lowers or raises the support stud. When the desired height is reached, the knurled knob is tightened to hold the wedge in position. The wedge holder is held in alignment by a guiding stud that rides in a shallow elongated slot in the main base. Supports of this basic design reduce setup time and eliminate the need for making or improvising special supports for each workpiece.

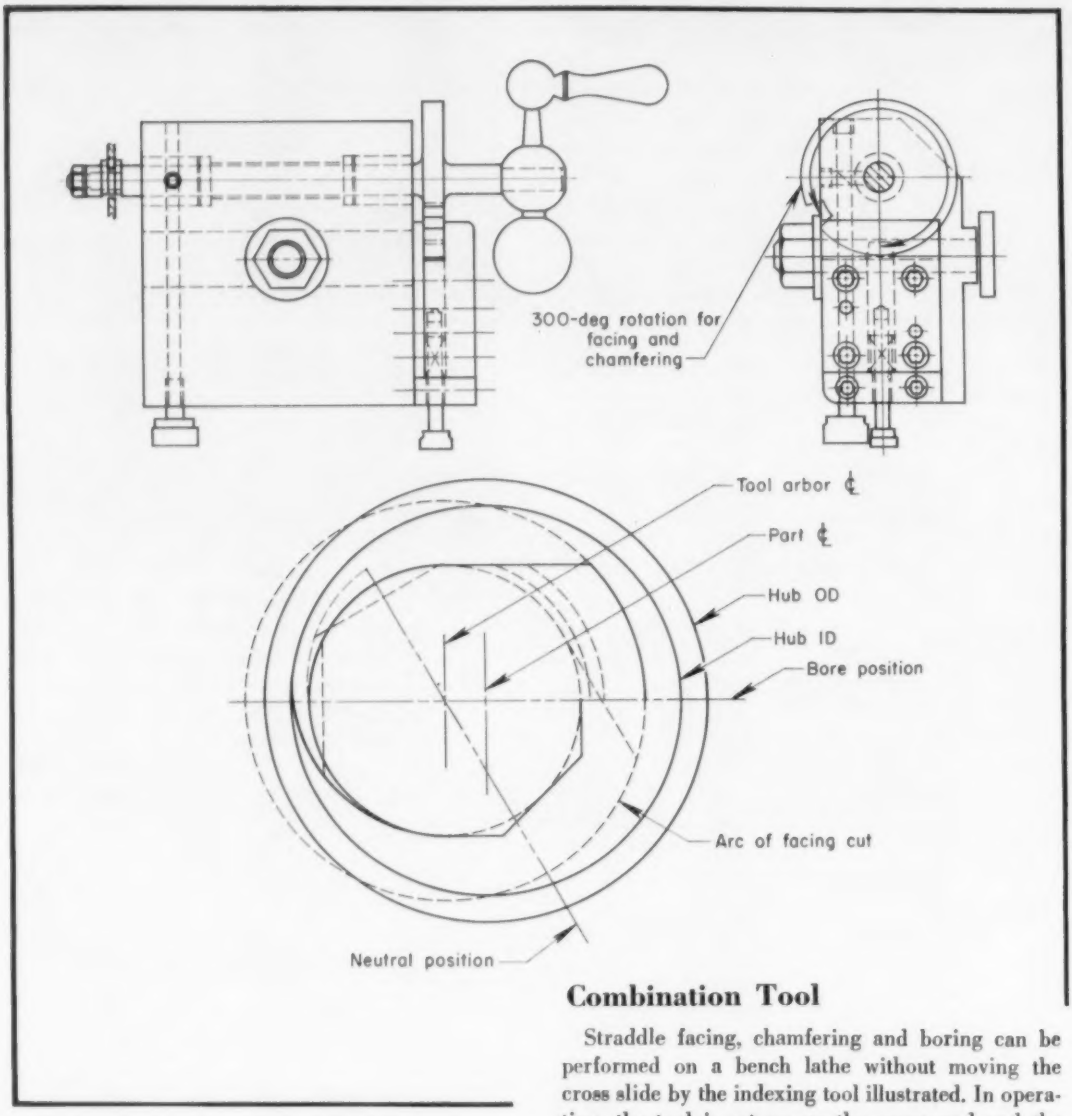
Cliff Bossmann
Dayton Chapter

Improved Mold Die

Sometimes it is possible to design or redesign a mold die so that subsequent machining operations on the part are minimized. The original die for the part illustrated performed satisfactorily, but when the gate was broken an extension was left. This extension was machined off. To eliminate the extra operation, the injection side of the mold was redesigned as shown. When gate breakage occurs, the end of the extension is under the upper surface of the part and does not have to be removed. Such a redesign is possible whenever the added indentation does not impair the function of the part.

A. Anderson
Dayton, Ohio





Combination Tool

Straddle facing, chamfering and boring can be performed on a bench lathe without moving the cross slide by the indexing tool illustrated. In operation, the tool is set up on the compound and the cross slide locked in position for the desired bore size. The tool is then set to neutral index and fed through the rough hole in the rotating workpiece to a depth stop. At this point, the tool is rotated through an arc of 300 degrees to boring index and locked. The rotation performs the facing and chamfering portion of the operation. Boring is performed by feeding the tool out through the hole.

Boring leaves no burrs, either on the faces of the part or in the bore itself. With some minor modification, the tool can be adapted to a wide variety of applications.

Fred Mayer
Endicott Chapter

Contributions for these pages describing short cuts for the tool engineer are welcome. Finished drawings are not necessary. Honorariums for accepted articles are sent upon publication.

Lathe Fixture

Many small machine tool accessory items require hold-down bolts that fit into circular T-slots. The heads of the bolts must be machined to the same radii as are on the sides of the circular T-slot in order to insure that the bolts slide freely in the slots.

The fixture illustrated enables eight bolts to be machined at once on an engine lathe. Square bolt heads are seated in slots cut around the face of a cast-iron fixture body and retained in place by a steel face ring. The ring is secured to the body by four socket-head cap screws.

While designed for small production runs only, this fixture can be adapted for higher production by using it on a turret lathe with a tool block that will cut the inside and outside radii at the same time.

H. J. Gerber
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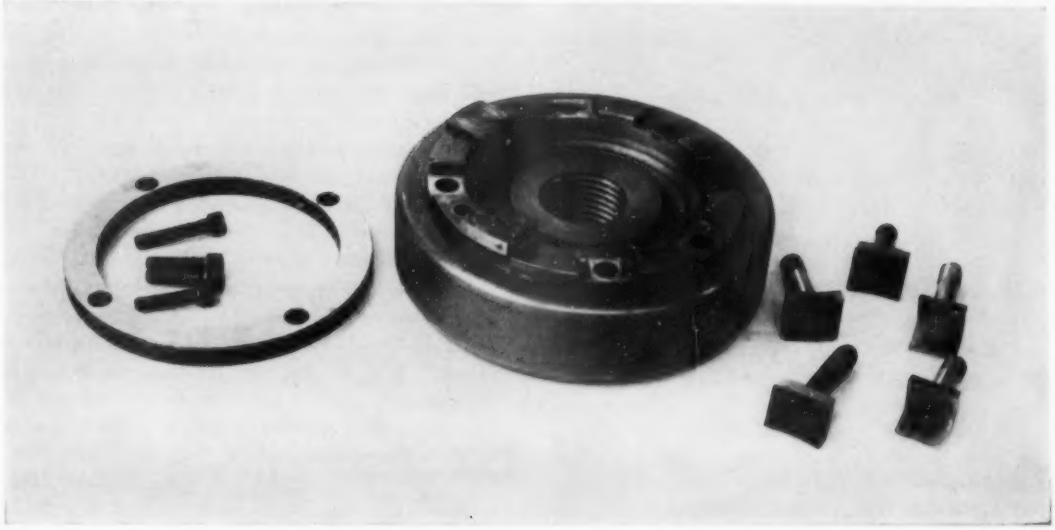

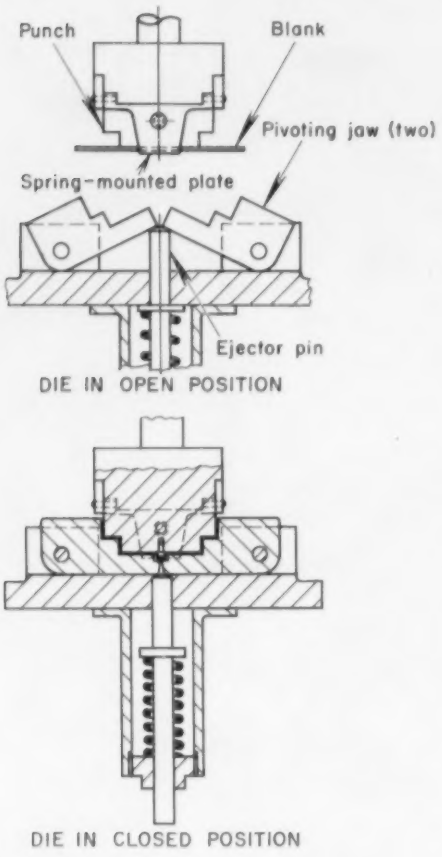

Bending Die

Normally, the workpiece illustrated would be formed in two simple bending dies. It is formed in one operation in the die shown. There is a fixed plate at the rear of the punch and a spring-mounted plate at the front of the punch. The blank is wedged between the two plates to hold it in position for forming.

The die consists of two pivoting jaws, held in the "open" position by a pin and compression spring. As the punch descends, the jaws are forced down. During this part of the forming operation, it is possible for metal to move longitudinally, so the material does not stretch or fracture. Forming is completed when the punch and jaws reach the closed position. On the upstroke of the press, the formed part is automatically ejected as the spring forces the jaws to the "open" position.

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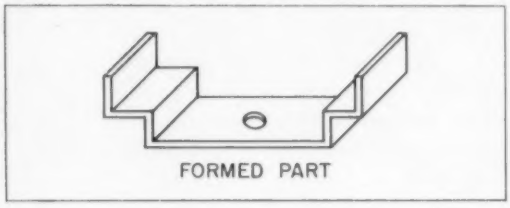
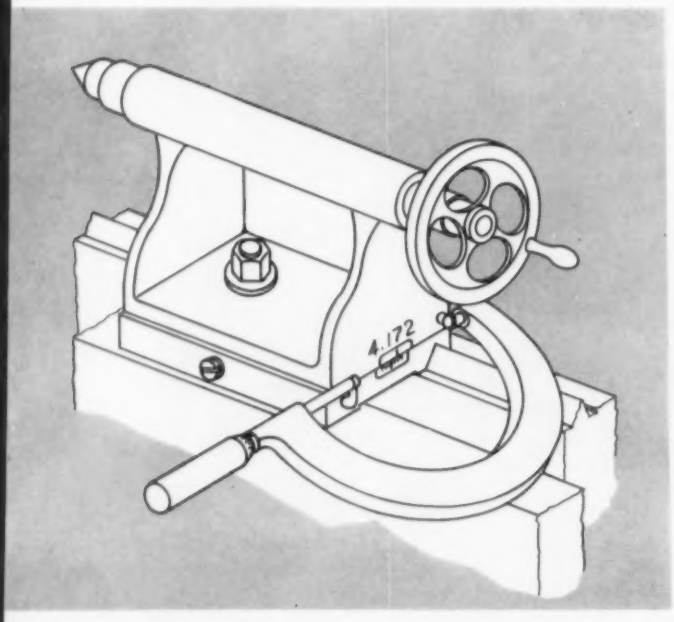
Uplands Vasby, Sweden



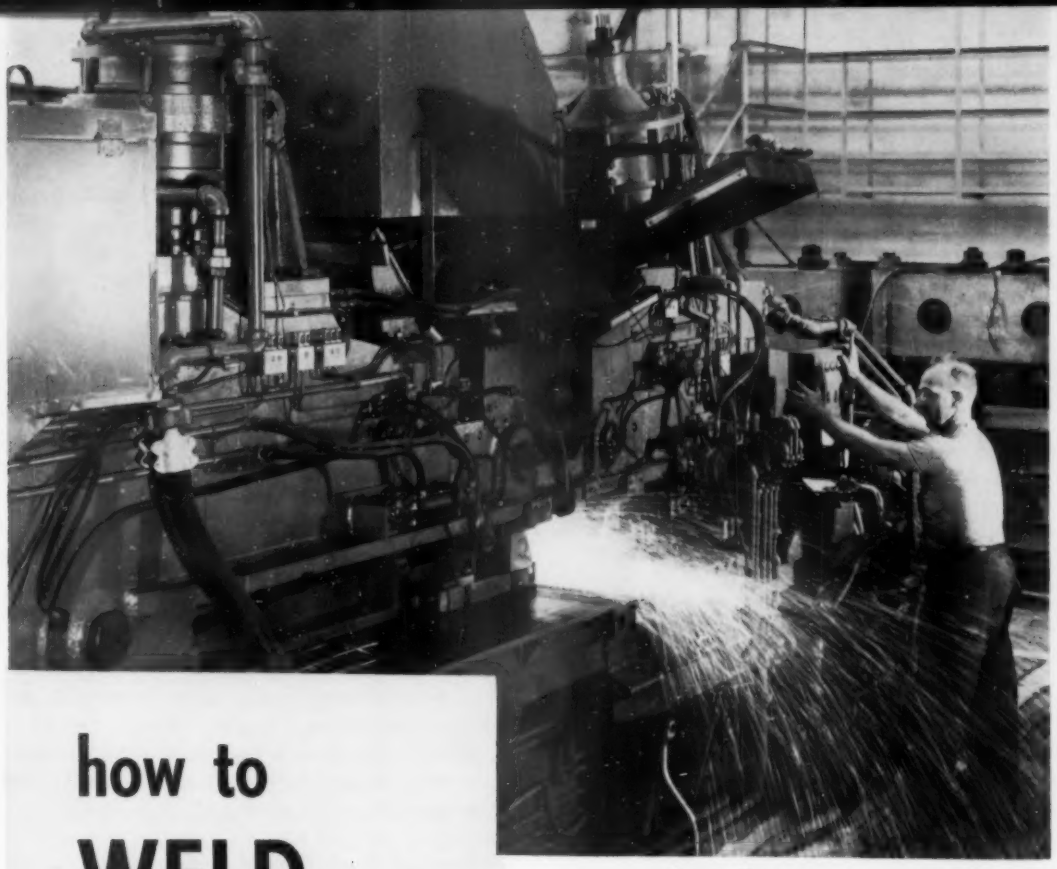


Centering Tailstock

A lathe tailstock is usually centered by trial and error. Adjusting in this manner is time consuming and when the stock is shifted for taper cuts, the adjustment must be repeated.

Illustrated is a quick and simple means of centering the tailstock and determining offset. Two holes are drilled and reamed in the back of the casting as shown. One is in the upper portion and the other is in the lower piece which is in contact with the machine ways. Pins, brazed to steel balls, are pressed into the holes. One pin is bent as shown to bring the two balls into the same horizontal plane. The dimension over the balls when the tailstock is properly centered is stamped on the casting. Any offset that may be required is simply added to the centered dimension.

Ernest Jones
Bronx, N. Y.



how to WELD TOOL STEELS

Fig. 1. Typical equipment for flash welding composite dies.

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Virtually all common tool materials except carbides can be welded. The success of welding operations depends on using correct procedures. These procedures are explained by the author, who also gives a number of actual examples.

Abstracted from Paper 191 "Welding of Tool Steels," presented at the 27th ASTE Annual Meeting. Copies of the complete paper will be available for purchase from Society Headquarters.

WELDING PROCESSES are important aids to the toolmaker. They can be used to construct composite dies, *Fig.* 1; to rebuild worn areas on existing dies; to repair broken dies; to correct machining errors; to accomplish design modifications; and to correct defects in tool materials. The degree of weldability of tool materials varies, depending on the composition of the materials and the alloys involved. Some tool steel compositions can be classified as having good weldability, while other grades require special welding procedures.

"Weldability" is difficult to define. The term is generally used to denote the requirements to produce a sound weld metal. Steels with good weldability require less preheat and simpler welding procedures. Steels which are classified as difficult to weld generally require careful attention to preheat and welding procedures. Some of the tool steels, such as the plain high-carbon grades, can be readily welded, requiring a minimum of preheat and standard welding procedures. Other types of tool

steels, such as the air-hardening grades, require a much higher degree of preheat and also careful attention to welding procedures.

Weld Quality

The chief requirement for tool steel weld metal is soundness of the deposited metal. Satisfactory hardness and durability are also essential. For those applications where the deposited weld metal must be machined to proper dimensions and later heat-treated for hardness, the weld metal must be capable

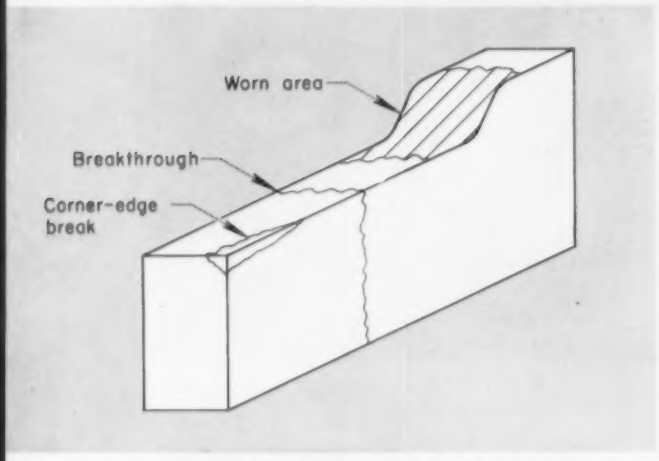


Fig. 2. Three major types of die repairs that are readily made by welding.

of heat treatment. Weld metal should be free from porosity, blowholes, pinholes, cracks, or slag inclusions. Penetration or fusion to the parent material should be excellent and physical defects such as undercuts should be avoided.

When the welding is performed in the proper manner, the soundness of the weld is equivalent to that of the parent material. While hardness with some ductility of the deposit is a major requirement, hardness alone, without toughness, may result in spalling, chipping, or cracking of the deposit in usage. A combination of maximum hardness with adequate toughness is most desirable for long tool life under production conditions.

Besides soundness, another quality which is important in all tool steel welds is the matching of the other properties of the weld with those of the parent material. In order to obtain matching characteristics, the composition of the deposited metal may differ from that of the parent stock. The criterion, however, for a successful weld deposit, is that it should match as closely as possible the hardness and wear-resisting properties of the parent material.

In tool steel welding, some of the common defects encountered with improper procedure are cracks in the weld metal, extensive porosity, poor fusion and distortion. Cracking of tool steel welds in many cases can be attributed to improper procedure, such as lack of preheat or too low a preheat temperature. Cracking can be eliminated with some types of tool steels by proper peening of the weld metal while hot.

Porosity is usually due to improper procedure, too-high or too-low welding current for example, and insufficient gaseous shielding during welding. Porosity may also be caused by defective metal-arc coated electrodes. Other causes of porosity are poor welding techniques, such as high or low arcs, and improper attention to details such as weaving versus beading procedures.

Control of distortion in tool steels is important, especially in the reworking of finishing tools where dimensional tolerances must be held to close limits. Distortion may be held to a minimum by proper peening procedure during welding and correct sequence of weld metal deposition. Distortion can also be minimized or eliminated by suitable preheating procedures. Another effective method of combating distortion is the use of welding fixtures and clamps to hold the parts in their proper relation during welding operations.

Types of Tool Repair

The most common types of repairs can be classified into three categories: broken edges, worn areas, and broken dies, as shown in *Fig.* 2. Broken edges are most generally encountered in blanking tools and repairs are readily made by welding. The most common tool repairs involve reconditioning of tools that are badly worn, especially drawing dies.

Another frequent type of repair is where tools and dies are broken completely through their sections. This type of repair welding procedure usually requires an extensive amount of welding and careful attention to the welding conditions.

Welding Processes

Today about fifty distinct and different welding processes are available to industry, and of these only a few are recommended for application to tool steel welding. The most common welding processes applicable to tool steel welding are: brazing, metal-arc welding with coated electrodes, atomic-hydrogen welding, oxyacetylene welding, inert-gas tungsten-arc welding, and flash welding.

Brazing is used to a limited extent in reconditioning of tools. The application of brazing of carbide tool bits into toolholders is well-known. To a limited extent, broken tools such as reamers and drills can be reconditioned by brazing the broken sections, making them satisfactory for light service. For severe service requirements, the preferable method is reworking by fusion welding. Metal-arc

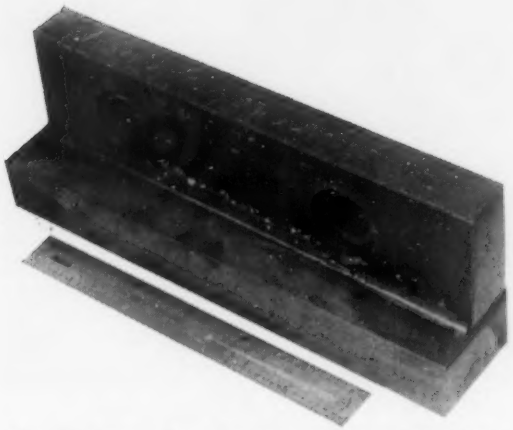


Fig. 3. Composite die made by flash welding high-carbon tool steel to low-carbon base.

welding is by far the most commonly applied process, using coated electrodes.

A great deal of development work has been carried out in producing suitable tool steel arc welding electrodes. These are available in various types and diameters, ranging from $\frac{1}{16}$ to $\frac{3}{16}$-inch sizes. Special "low-hydrogen" type tool steel electrodes have a special coating. In the manufacture of these electrodes, every precaution is taken to reduce the hydrogen content in the coating, which comes from moisture in the ingredients or moisture that may be absorbed from the atmosphere during storage. It is therefore extremely important, when using coated electrodes for metal-arc welding, that the low hydrogen type electrodes be stored in heated ovens. Hydrogen in the coating itself is liberated in the arc stream and will dissolve and diffuse into the weld metal. This causes porosity or a brittle condition in the weld metal or heat-affected zone, resulting in small cracks or embrittlement.

Atomic-hydrogen welding is commonly used in the repair welding of dies, and is generally limited to those applications where it is desired to have weld metal similar to that of the parent material.

The basic principle of this process is that the molecular hydrogen flowing across the arc between two tungsten electrodes is disassociated into atomic hydrogen. When this atomic hydrogen recombines to form molecular hydrogen, great heat energy is liberated, and the heat is sufficient to melt some of the highest melting point metals such as tungsten. The atomic-hydrogen process is used for the welding of some tool steels where the composition of the weld metal is critical, such as repairing high-speed tool steel and broken or chipped surfaces of tool steels where only a small amount of repair is necessary.

The function and reaction of the hydrogen differs markedly between the atomic-hydrogen process and coated electrode welding. In the atomic-hydrogen process the hydrogen is allowed to recombine to form molecular hydrogen, which is not absorbed by the weld metal. In coated electrodes the hydrogen is liberated in its atomic form, which dissolves readily in the weld metal.

With the atomic-hydrogen process, it is necessary to use a filler wire of the proper composition to generally match that of the parent material. The advantage of this process is that no flux is required. With the proper procedure, smooth and sound weld metal is deposited and control of the heat can be adjusted gradually, so that the weld can be feathered out in thin areas to the desired thickness.

A disadvantage of this process is that the torch cannot reach confined spaces. Also, filler metal for some of the tool and die compositions is not always available in the wire form for this process.

Oxyacetylene gas welding is used only to a limited degree. Because of the large quantity of heat

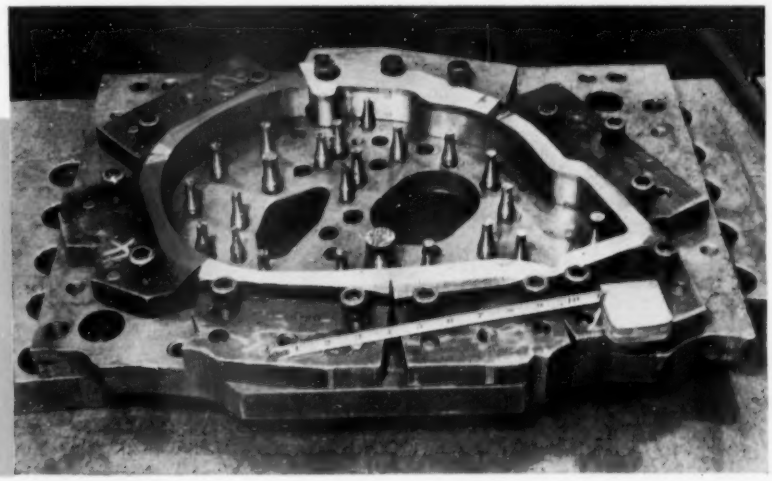


Fig. 4. Composite blanking and piercing die assembly.

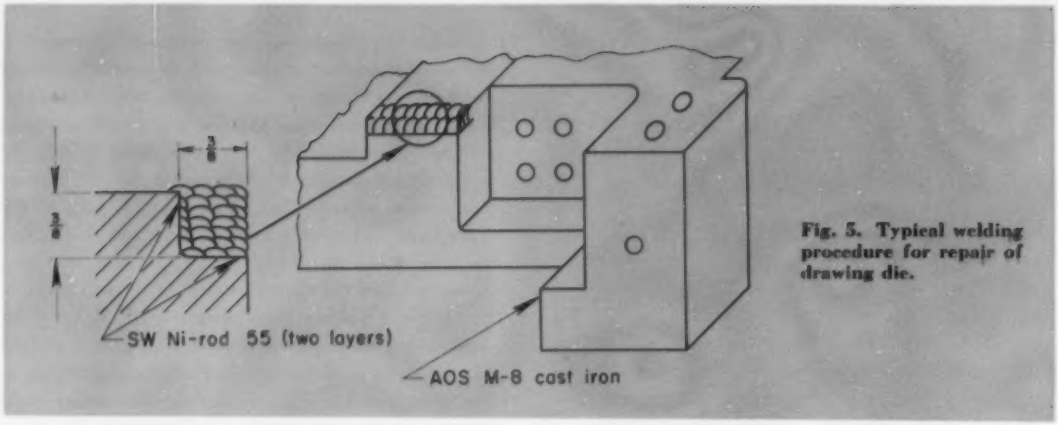


Fig. 5. Typical welding procedure for repair of drawing die.

Fig. 6. Riveting die, chamfered for welding.

generated, distortion is one of the chief difficulties encountered. This process requires addition of filler metal of the proper composition. One of the main disadvantages of this process is that the base metal must be heated to the fusion point before a satisfactory weld can be obtained. This generally results in overheating of the parent stock.

Inert-gas tungsten-arc welding was developed during the last war, and has found limited applications in welding of tool steels. The principle involves the use of a tungsten electrode surrounded by a cup, using either helium or argon gas for shielding. An application is the repair of defects in oil-hardening alloy cast-steel dies.

Flash welding is one of the oldest welding processes developed, and is used primarily for applications such as composite tool steel dies. Operations are almost entirely automatic. A heavy current is passed between two parts causing flashing of the metal with the resultant heating of the edges to the proper temperature, at which time pressure is applied quickly to form an upset. A flash-welded composite die is shown in *Fig.* 3. A number of such dies are used in the construction of the composite blanking and piercing die assembly shown in *Fig.* 4.

Welding Procedures

For the various welding processes applicable to tool steels, it is important and highly desirable that written welding procedures be formulated, so that the welding technician can follow precisely the various steps and operations. Accurate records should be kept of the tools that have been repaired, for future reference on cost information and the service performance of the tools.

Welding procedures will vary to a great extent with the various types to be welded. A welding procedure for a water hardening steel may differ from that for oil hardening, air hardening, or high-speed tool steels in many respects. Some of the variables are: degree of preheat, type of weld metal to be added, and post heat-treating operations.

The welding procedure must include the following information:

1. Process
2. Preparation prior to welding
3. Preheat to be used
4. Electrode or filler metal to be used
5. Technique or method of application
6. Postwelding heat treatment
7. Inspection.

A typical tool steel welding procedure drawing is shown in *Fig.* 5.

Typical Welding Recommendations

For the welding of the various types of tool steels, general recommendations for each type are given. Modifications of these procedures may also

be entirely satisfactory, so that no hard-and-fast rule can be set up as to the type of electrode or welding process to be selected. The recommendations should serve merely as a guide in repair welding of the types of steels that are discussed in this article.

Water Hardening Steels: The selection of the electrode or filler metal for welding of the water-hardening steels depends to some extent on the type of repair necessary and on the service requirement of the tool. For blanking dies requiring a sharp shearing edge, the tools are usually in the hardened condition when repairs are necessary, and for this service condition it is recommended that the electrode or filler metal selected be of the high-carbon 4-6 percent chromium-molybdenum composition. Where there is considerable depth in the repair, it may be advisable to use a low-carbon 4-6 percent chromium-molybdenum composition for the first layer or two, and then finish the built-up weld with high carbon 4-6 percent chromium-molybdenum material.

After each bead is deposited, the surface of the weld is carefully peened. A standard ball peening hammer can be used. For larger sections, a pneumatic air hammer with a suitably formed peening tool is used.

For those applications where the tools are in the annealed or soft condition and weld metal is required to build up to the proper dimensions, a weld deposit made with 1 percent carbon, 0.2 percent vanadium is recommended. This type of weld metal is responsive to heat treatment and will result in a hardness similar to that of the parent stock. Where tool steels of this composition are flame-hardened, it is recommended that a filler metal or electrode of the high-carbon-vanadium analysis be used. With this type of weld metal the response to the flame hardening operation is excellent, and the hardness of the weld deposit is comparable to the parent material. It is important to note that when the high-carbon 4-6 percent chromium-molybdenum weld metal deposit is used, heat treatment by water quenching must be avoided, as it results in cracking of the weld deposit. This type of weld deposit should be applied only for hardened tool steels that will not require further heat treatment.

Approximate weld metal hardness is as follows:

Low carbon 4-6 percent chromium-molybdenum weld metal: 38-40 Rc
High carbon 4-6 percent chromium-molybdenum weld metal: 55-60 Rc
1 percent carbon-0.2 percent vanadium (as deposited): 32-34 Rc
1 percent carbon-0.2 percent vanadium (after quenching or flame hardening): 54-62 Rc.

A preheat temperature of 350-450 F is generally recommended, although higher preheat can be used. For some applications it is important to have this preheat range as a minimum. The higher range of the preheat should not exceed the draw temperature which is used in the heat treatment of the tools.

Repairs in hardened small-size tools may be allowed to cool normally to room temperature. For some complicated shapes or large sections, it is advisable to cover the repaired area with asbestos cloth or paper so that cooling is delayed.

For those applications which require machining after repair welding, it is generally necessary to give the welds a stress-relieving or tempering heat treatment, which may consist of heating to 1150-1200 F for one hour per inch of thickness, followed by furnace cooling to 600 F, and then air cooling. This will permit machining of the welds without encountering hard spots or marked differences in hardness between the parent stock and the weld metal. For some large complicated tools in the hardened condition, it may be necessary to give

Fig. 7. Surface of cast forming die built up by welding to permit design modification.

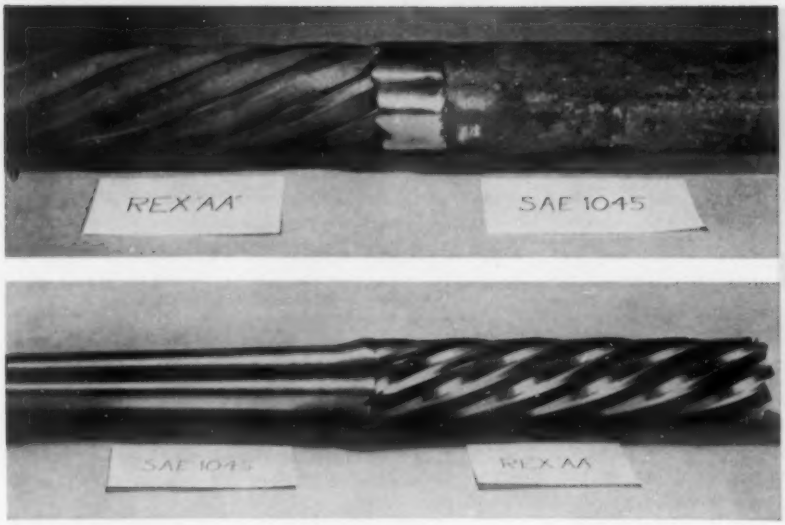


Fig. 8. Reamer after repair welding (top) and after machining to size (bottom).

a stress-relieving or draw treatment in order to relieve welding stresses. It is usually necessary to heat for a period of 5 to 8 hours at a temperature range of 500-700 F, depending on the draw temperature used in the heat treatment of the tool. The draw temperature should never be exceeded. This postwelding heat treatment is recommended for complicated tools.

After the repair welds have been completed and the sections are cold, areas should be critically examined for any surface defects such as cracks, excessive porosity, undercuts, etc. Further inspection should be made by magnetic-particle or dye-penetrant methods, to detect any small incipient cracks which are not apparent on visual examination. If repairs are necessary, the same welding procedure indicated for reconditioning tools should be used.

Oil-Hardening and Hot-Working Steels: The characteristics of hot-working and oil-hardening steels are similar with respect to repair welding procedures. The metal-arc coated-electrode, atomic-hydrogen, and inert-gas-shielded tungsten-arc welding processes are recommended.

For the metal-arc coated-electrode welding process, the low-carbon 4-6 percent chromium-molybdenum electrode is used for most applications. Where hot-working steels or oil-hardening steels are used for shear blade applications, the high-carbon 4-6 percent chromium-molybdenum electrode is recommended. For maximum toughness and wearability, a low-carbon 7-9 percent chromium-molybdenum electrode is recommended.

For the atomic-hydrogen and inert-gas-shielded tungsten-arc welding processes, wire filler metal of the low-carbon and high-carbon 4-6 percent chromium-molybdenum composition is used. For high temperature working conditions, especially for shear blades, a repair weld having high-strength and high-temperature properties is recommended, using the hydrogen process. Typical deposit compositions are: 2.5 percent C, 30 percent Cr, 50 percent Co and 12 percent W (Stellite No. 1); and 1 percent C, 28 percent Cr, 62 percent Co and 4.5 percent W (Stellite No. 6). For repairs of worn areas in hot working tool steels, the low carbon 4-6 percent chromium-molybdenum weld metal deposit is recommended. For this type of tool steel, peening of each weld bead after depositing is desirable.

Approximate weld metal hardness is:

Low carbon 4-6 percent chromium-molybdenum (after stress relieving or tempering at 700 F): 40-44 R_c
High carbon 4-6 percent chromium-molybdenum (after tempering at 700 F): 55-60 R_c
Stellite No. 1: 45-55 R_c
Stellite No. 6; 35-45 R_c
High carbon 4-6 percent chromium-molybdenum (heat treated, oil quenched, and tempered at 275-400 F): 55-60 R_c

A preheat at 350-450 F is desirable. High preheat below the draw temperature may be used in some applications.

For large dies and composite dies, stress relieving after welding is recommended. Stress-relieving temperature is generally about the same as the draw temperature and may be in the range of 600-700 F. For machining after welding, a stress-relieving or stress-annealing heat treatment of 1150-1200 F is recommended. This is followed by furnace cooling to 600 F and air cooling.

Air-Hardening Tool Steels: The air-hardening types of tool steels can be satisfactorily repair welded in the hardened condition, provided the areas to be repaired or the extent of weld metal required are relatively small. For major repairs in

large sections, it is recommended that the tool be annealed prior to welding and rehardened after welding is completed.

The metal-arc coated-electrode process, the atomic-hydrogen process, and the inert-gas-shielded tungsten-arc processes are recommended. For many applications, there is a distinct preference for the atomic-hydrogen and the inert-gas-shielded tungsten-arc welding processes.

A weld deposit that has characteristics similar to that of the air-hardening tool steels is required for most applications. Where coated electrodes are used, both low-carbon and high-carbon 4-6 percent chromium-molybdenum electrode compositions are satisfactory. The low-carbon 4-6 percent chromium-molybdenum is applied first and sandwiched between layers with the high-carbon 4-6 percent chromium-molybdenum electrode. The working surface of this weld deposit is finished with the high-carbon 4-6 percent chromium-molybdenum electrode to give it the required hardness. This sandwiching of the low and high-carbon 4-6 percent chromium-molybdenum weld metal has been found important to prevent cracking and to give a sound weld deposit.

For the atomic-hydrogen or the inert-gas-shielded tungsten-arc processes, wire filler metal of the same composition as the tool material can be used. For example, one type of filler metal composition is: 1.5 percent C, 12 percent Cr, 1 percent Mo, and 3.5 percent Co. Peening is also recommended for this type of tool steel weld deposit. Peening is generally applied immediately after a short length of weld deposit has been made. Approximate weld metal hardness of the high-carbon 4-6 percent chromium-molybdenum weld deposit, after stress relieving at 950-1000 F, is 56-60 R_C.

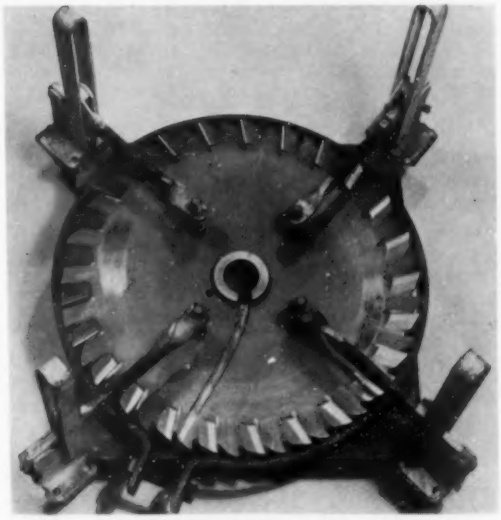


Fig. 9. Cracked milling cutter in holding fixture, ready for repair welding. Area along crack is grooved prior to welding to provide space for weld metal.

A higher preheat than required for other types of tool steels is mandatory for annealed or hardened air-hardening tool steels. This preheat is generally from 850-1000 F. Preheat can be accomplished by heating the tools in a furnace or in the case of small tools, with oxyacetylene burners. Care should be taken that the tool is uniformly heated and that the temperature is maintained until all welding has been completed. After welding, the temperature should again be checked to see that the preheat is up to the required range. The tool is then placed in a furnace which is heated to the preheating temperature range.

Tools in the hardened condition are stress relieved in a furnace immediately after welding, at 950-1000 F for one hour per inch of thickness, and allowed to air cool. The postwelding heat treatment for steels in the annealed condition, where machining of the weld metal after welding is required, consists of placing the tool in a hot furnace, raising the temperature to 1150 F, holding for one hour per inch of thickness, then cooling in the furnace to 300 F at normal cooling rate, and then air cooling. For rehardening of the tool, a complete heat treatment is necessary.

High-Speed Tool Steels: Welding of high-speed tool steels is considered to be difficult and careful attention to welding procedures is required. The metal-arc coated-electrode, atomic-hydrogen and inert-gas tungsten-arc processes can be used. For most applications, the inert-gas-shielded tungsten-arc and atomic-hydrogen processes are preferred to other processes.

Metal-arc coated electrodes of the molybdenum type of high-speed tool steel composition are most often used. These electrodes are suitable for both the molybdenum and tungsten types of high-speed tool steels. For application with the inert-gas tungsten-arc or atomic-hydrogen welding processes, filler wire of the appropriate high-speed tool steel composition is applied. Two typical filler wire compositions are: 0.75 percent C, 0.4 percent Cr, 18 percent W, 0.85 percent V; and 0.80 percent C, 4 percent Cr, 1.20 percent W, 8.00 percent Mo, 1 percent V. Other compositions are available.

Preheat is critical in the welding of high-speed tool steels, especially where parts are small. Preheat temperature is 850-900 F. Peening is also recommended for the high-speed tools and must be carefully applied.

After welding has been completed, the part is placed in a furnace heated to 850 F, held for one hour per inch of thickness, and then furnace cooled to room temperature. Typical weld metal hardness may range from 58 to 62 R_C. Critical inspection of

the welds is important to be sure that defects have been properly repaired and that the weld areas are sound and free from cracks.

Tungsten Carbide: Tungsten carbide dies are not considered to be weldable. There have been many applications where hard facing of tungsten carbide has been accomplished by fusing tungsten carbide to the surface of tool steels, using the atomic hydrogen and inert-gas-shielded tungsten-arc processes. In some methods of application, tungsten carbide and cobalt mixtures are sprayed on tool steels and later bonded to the tool steel by heating to high temperatures. This application appears to be promising, but requires further investigation.

Rebuilding of Worn Areas: When building up worn areas, the die should be carefully cleaned and checked for presence of cracks, using magnetic-particle or dye-penetrant methods of inspection to be sure that cracks are removed. Generally, it is necessary to make templates of the required thickness, so that the welder can gage the amount of weld metal put on. There should be sufficient metal for clean-up, but not so much that removal of excess material is a problem.

A thin layer will not be satisfactory. Usually it is necessary to grind or scarf an area so that a good foundation of the repair weld metal can be made. Metal can be removed by grinding, by arc air-cutting, or by flame gas-gouging. However, with arc-cutting or flame gouging, it is necessary that the tools be preheated to 350-450 F in order to avoid cracking during metal removal.

If the original material is worn and the material is of special cast iron which has been heat treated, it is necessary to deposit a buffer layer of 55 percent nickel filler metal, which is then overlaid with a hard-surfacing material such as 7-9 percent chromium electrode. In some areas that are subjected to wear but are not in a critical location, the application of hard-surfacing electrodes to the cast-iron die may result in small cracks. It has been found that weld deposits made directly in these less critical areas result in cracks which do not seem to propagate and have no adverse effect on tool life.

Forming Dies: Welding of punches, drawing and forming tools and blank holders presents no unusual problems. Special inserts are normally used in the critical areas of forming dies. When these inserts are worn, they are individually repaired by building up to the proper dimensions. The procedure used will depend on the type of die material employed.

Broken Dies: Breaks through sections of dies constitute a serious problem in tool maintenance. It is necessary to chamfer out the section and to weld from both sides, so that a strong weld is obtained, as shown in *Fig.* 6. Data for a typical application are:

Material:	Fire die (air hardening steel)
Composition:	0.35 percent C, 0.35 percent Mn, 0.95 percent Si, 5.25 percent Cr, 1.35 percent Mo, 0.50 percent V
Process:	Metal-arc coated electrodes
Electrode:	5/16-inch low carbon (4-6 percent Cr-Mo)
Preheat:	600-700 F
Postwelding heat treatment:	600 F for 2 hours, air cool
Inspection:	Visual and magnetic particle

Design Modification: In the application shown in *Fig.* 7, a die of cast alloy steel used for drawing operations was repair welded because of major design changes after the casting was delivered. Pertinent data are:

Fig. 10. Repair-welded expander die. Material is 4-6 percent Cr-Mo Alloy cast steel.

Process recommendation:	Metal-arc coated electrodes
Chemical composition of castings:	0.5 percent C, 0.6 percent Mn, 0.35 percent Si, 1 percent Cr, 0.45 percent Ni, 0.40 percent Mo, 0.10 percent V.
Electrodes:	5/32 inch low-carbon 4-6 percent Cr-Mo 5/32 inch high-carbon 4-6 percent Cr-Mo

Preheat and interpass temperature:	350-450 F

Welding specifications for this job read as follows: Use low-carbon 4-6 percent chromium-molybdenum electrodes for build-up of base material to within $\frac{1}{8}$ inch or $\frac{3}{16}$ inch of the finished dimension. Use high-carbon 4-6 percent chromium-molybdenum electrodes for the outer wear surfaces for at least three layers of weld metal. To minimize distortion and the welding stresses, it is recommended that the welding be performed in alternate direction of travel from one layer to the next. For best wear resistance, this grade of low alloy cast steel is hardened by flame heating and air quenching instead of water quenching, as is normally done in flame hardening of tool steels. The weld metal used responds to this form of hardening procedure.

Perishable Tools: Taps, rollers, drills and cutters of all kinds are considered perishable tools. When these are broken, depending on the service conditions to which they are exposed, they may be repaired by brazing and arc welding. *Fig.* 8, shows a reamer that has been repaired by the atomic-hydrogen process. Shank material is 1045 steel. The cutting section is high-speed steel.

A high-speed milling cutter, *Fig.* 9, was also repaired by the atomic hydrogen process, using filler metal of high-speed steel composition.

The general procedure for the atomic hydrogen process is as follows:

Hydrogen pressure:	1½ lb on gage
Amperes:	20 (ac)
Preheat:	850 F
Interpass temperature:	850-900 F
Filler Metal:	⅛-inch diameter wire
Postwelding heat treatment:	Place in electric furnace at 850 F, hold for 1 hour, furnace cool to room temperature (in fixture).

Shearing Blades: Shearing blades for cutting steel are subjected to tremendous shock under service conditions and will require proper repair welding in order to justify their cost. Usually shear blades are very hard and have to take a lot of abuse. Shear blades can be successfully welded and placed back in use.

The welding procedure for a typical job is:

Type of steel:	Heppenstall EIS 97
Chemical composition:	0.55 percent C, 1.00 percent Mn, 2.15 percent Si, 0.30 percent Cr, 0.38 percent Mo.
Electrodes:	Low-carbon 4-6 percent chromium-molybdenum High-carbon 4-6 percent chromium-molybdenum
Amperes:	185
Volts:	24 (d-c reverse polarity)
Preheat:	400 F
Sequence of welding:	a) First two layers made with $\frac{3}{32}$-inch diam low-carbon 4-6 precent chromium-molybdenum electrodes, using the back-step method b) Additional layers then made with high-carbon 4-6 percent chromium-molybdenum electrodes
Postwelding heat treatment:	Immediately after welding, the blade is placed in an electric furnace and heated to 600 F for 2 hours, then air cooled.

Castings: Some dies made of cast alloy steel may contain porous areas along important locations which must be repair welded. One such die, made of 4-6 percent chrome cast steel is shown in *Fig.* 10. The repair welding procedure for this massive casting was as follows:

Remove all porous metal	
Preheat:	500-600 F
Electrodes:	AOS Diamondweld "D"
Postwelding:	Stress relieve at 1200 F for 6 hours
Heat treatment:	Furnace cool to 300 F and air cool.

It is evident that tool engineers should give consideration to the proper selection of tool materials to avoid breakage or excessive wear. However, when tools do break, they can be repaired by welding. An ideal tool material is readily weldable in addition to having the necessary hardness and toughness. While many of the recommendations in this article are general in nature, they do illustrate a sound approach to lower tool costs.

CORRECTION: In the article, "Designing Form Tools for Optimum Use of Side Clearance" by Allen M. Johnson in the April issue, an unfortunate error occurred.

The formula in the last paragraph on page 131 reads:

$$\tan h = \tan Y \ (\sin Z)$$

where h is side clearance angle, Y is chamfer angle and Z is front clearance angle.

The functions of these angles should have been reversed. Thus the corrected formula reads:

$$\tan h = \sin Y \ (\tan Z)$$

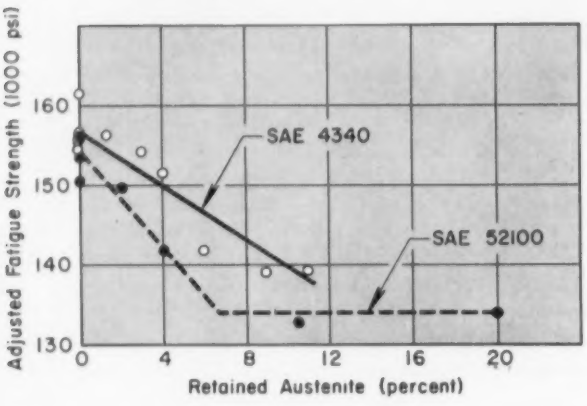
Mr. John W. Lane of Chapter 37 was one of several readers who noticed this error. The editors are indebted to Mr. Lane for his promptness in calling this slip to their attention.—ED.

FATIGUE PROPERTIES of high-strength steels

ALTHOUGH FATIGUE PHENOMENA have been studied for more than a century, little work has been done on some of the metallurgical aspects of fatigue failure. In an effort to resolve some of the conflicting views on fatigue failures, a comprehensive study was recently made at the National Bureau of Standards.

Experiments conducted in cooperation with the University of Maryland showed that retained austenite, in increasing amounts up to 10 percent, lowers fatigue strength. The tests also demonstrated that fatigue stressing transforms retained austenite to untempered martensite, which probably accounts for the deleterious effect. Results of the research are expected to have practical applications in the processing of the high-strength steels used throughout industry.

Fatigue strength decreases as the amount of retained austenite increases.



The study was undertaken in an attempt to learn how controlled variables such as carbon content, tempering temperature, cooling method for hardening, and refrigeration—and dependent variables such as retained austenite and hardness—are related to fatigue strength. Specimens were made of four low-alloy steels whose carbon contents ranged from 0.44 to 1.06 percent. They were tested on R. R. Moore type rotating-beam fatigue testing machines that were run at a maximum speed of 8000 rpm. The machines operated until complete specimen fracture occurred.

Preliminary experiments indicated that the usual method of preparing fatigue specimens can often mask surface metallurgical effects that can be of prime importance. Consequently, all specimens were prepared as follows: each blank was ground and given a final polish, then copper-plated prior to heat treatment. After heat treatment and stripping of the protective coating, no further polishing was necessary. The specimens were therefore free from any surface changes induced by mechanical working.

There was a strong correlation between fatigue strength and hardness so the data for each steel were adjusted to an average hardness before the effects of other variables were evaluated. For each steel, the adjusted fatigue strength decreased as the amount of retained austenite (determined by X-ray diffraction analysis) increased, as shown in the accompanying figure. For the three higher-carbon steels there appeared to be a limiting value of approximately 10 percent beyond which no further decrease in strength occurred. Specimens refrigerated before tempering were observed to possess greater fatigue strengths than unrefrigerated specimens. These results indicate that refrigeration tends to reduce the amount of retained austenite.

Measurements on tested specimens showed that not only does fatigue stressing transform retained austenite, but that the extent of the transformation depends on the stress amplitude. This transformation under stress may account for the damaging effect of retained austenite.

Compound Angles

...nomogram simplifies solution

By C. W. Peters
Process Engineer
Adamas Carbide Corp.
Kenilworth, N. J.

Compound angle calculations constitute much of the mathematical work found in manufacturing plants. These are laborious when conventional methods are used. The author presents a nomogram method that reduces calculations on compound angles to a minimum.

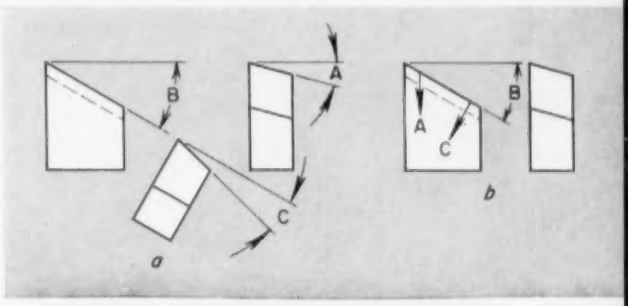


Fig. 1. Rectangular block with one face cut off to form a compound angle. (a) Normal projection with auxiliary view. (b) Suggested simplification to convey the same data about the angular relationships.

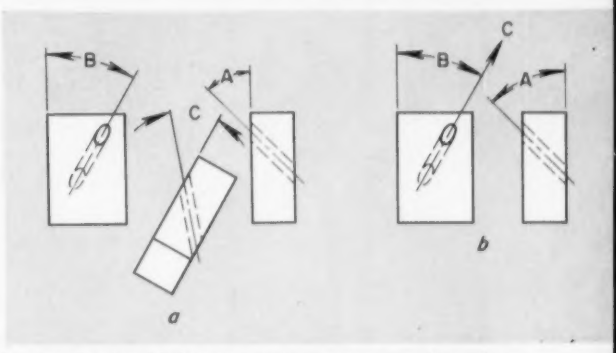


Fig. 2. Block with hole located in a compound angle position. Conventional presentation of the angular dimensions is shown in (a) with the suggested simplification in (b).

CALCULATIONS in tool manufacturing usually require the determination of compound angle sizes to facilitate machining. Often, the time required to find an angle is greater than the production time on the workpiece. Examples of these conditions are found in drilling angular holes relative to a flat surface or in the grinding of tool bits for special rake and clearance angles.

A convenient method of handling compound angles is to find the relationship between the angle and its projection on another plane. These projections are found on drawings in the form of auxiliary views. In *Fig.* 1a, a rectangular block is cut off at a compound angle, and the auxiliary view is used to complete the graphical description. However, the same information is provided by the notation of *Fig.* 1b that shows angles *A* and *C* as two different projections, or measurements, of the same angle. These measurements are related by the equation:

$$(\text{Tan } A)\ (\text{Cos } B) = \text{Tan } C$$

For convenience of calculations, angle A is called the form angle, angle *C* the full angle and angle *B* the turn angle. *Fig.* 2 illustrates the case of a hole in a block located at a compound angle. It can be seen that the form angle and the full angle are measured as the complements of the angles relative to the surfaces. By reversing this angular position, the formula for the relationship remains the same. Thus, a consistent definition can be developed for the form and full angles.

Assuming a basic rectangular shape for a part, form and turn angles appear on or through perpendicular faces, and the full angle retains a three-dimensional character. This definition, with data provided by a drawing, permits the use of a nomogram, *Fig.* 3, for most calculations, regardless of the machining position or the holding fixture. It is possible that the drawing may give two angles, or their complements, not related by the equation of the nomogram. In this special case, a solution is generally possible by using two straight edges to find the solution. This case is illustrated in *Fig.* 3 with the complete solution for a special condition.

In addition to solving for missing angular dimen-

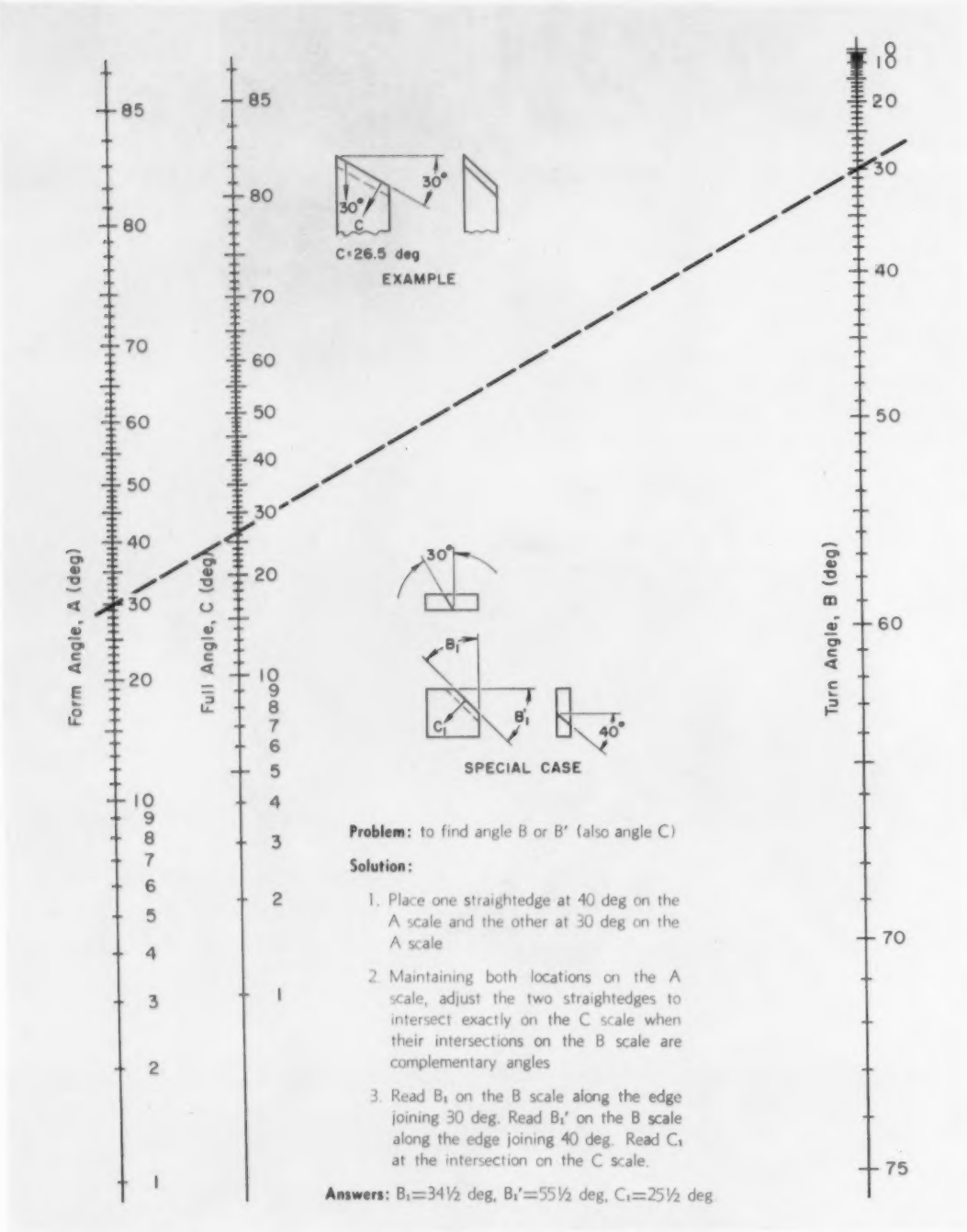
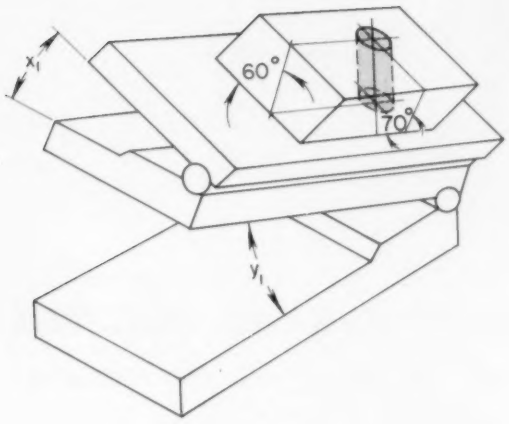

Form Angle, A (deg)
Full Angle, C (deg)
Turn Angle, B (deg)
30°
30°
C
C=26.5 deg
EXAMPLE
30°
B1'
C1
B1
40°
SPECIAL CASE
Problem: to find angle B or B' (also angle C)
Solution:
1. Place one straightedge at 40 deg on the A scale and the other at 30 deg on the A scale
2. Maintaining both locations on the A scale, adjust the two straightedges to intersect exactly on the C scale when their intersections on the B scale are complementary angles
3. Read B1 on the B scale along the edge joining 30 deg. Read B1' on the B scale along the edge joining 40 deg. Read C1 at the intersection on the C scale.
Answers: B1=34½ deg, B1'=55½ deg, C1=25½ deg

Fig. 3. Nomogram for compound angles, based on the equation (*Tan A*) (*Cos B*) = *Tan C*.



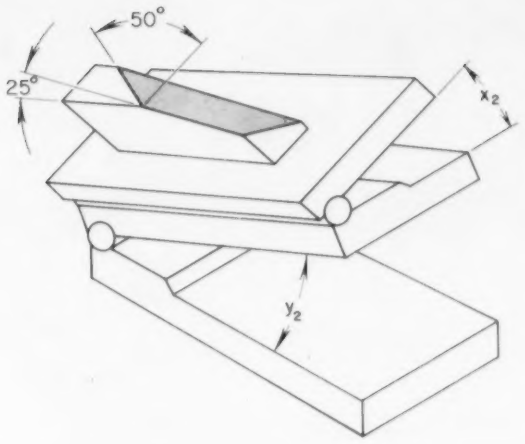


Fig. 4. (above) Typical setup for drilling a hole located in a compound angle position.

Fig. 5. (upper right) Fixture for machining a block that contains a surface formed by a compound angle. The tool is mounted in a horizontal spindle.

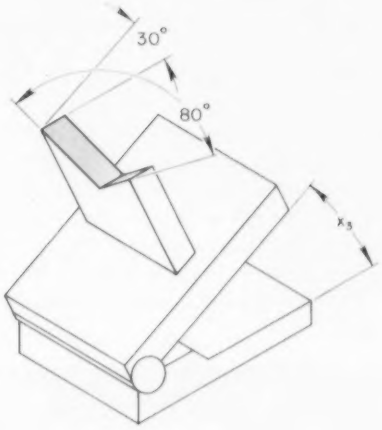


Fig. 6. (right) Workpiece located in a fixture for machining a V-groove. With the compound angle being formed by the rotation of the workpiece, the included angle on the tool must be calculated, which was found to be 44 deg for this case.

sions, corrections must be made for the rotation or tilting of a workpiece. These dimensions can also be found on the nomogram. Typical examples of problems found in industry clarify the methods used for finding the desired information when using the nomogram system.

To drill a hole, as shown in *Fig.* 4, angles X_1 and Y_1 of the fixture must be set so that the center line of the hole is located in a vertical position relative to the vertical center line of the drill. Angle X_1 is equal to the complement of the 60-deg form angle (A), or 30 deg. Angle Y_1 is the complement of the angle C in a plane parallel to Y_1, of which 70 deg is the projection. Using the nomogram, the answer is found by aligning 30 deg on the B scale with 70 deg on the C scale. The value for the angle on the form scale is 72.5 deg and the complement, Y_1, is equal to 17.5 deg.

Another common machining problem is found in the grinding of a compound-angled surface of a workpiece, *Fig.* 5. In this case, the part being ground must be located relative to a grinding wheel mounted on a horizontal spindle. This means that angles X_2 and Y_2 must bring the surface to a horizontal position. Angle X_2, the form angle on the end of the piece, is not given. It is known, however, that the turn angle with respect to the 50-deg form angle is the complement of 25 deg or 65 deg. From this information, it can be determined that the full angle is 26½ deg. This additional fact is enough to find the missing form angle of 29 deg. Therefore, X_2 is also 29 deg. Angle Y_2 is the turn angle corrected for this rotation. To find this angle on the nomogram, 29 deg is found on the turn scale and aligned with 25 deg on the form scale. The answer for angle Y_2 is found by reading the answer on the full angle scale, which is 22 deg for these conditions.

Another type of problem is the machining of a V-groove in the piece, *Fig.* 6. This operation is done by placing the piece on the fixture as shown and setting X_3 at 30 deg. To find the included angle needed on the grinding wheel it is necessary to work with only half of the V-angle. By joining 40 deg on the full scale with 30 deg on the turn scale the form scale reads 44 deg. Thus, the wheel must be dressed to provide an included angle of 88 deg on the periphery.

From the above examples it can be seen that the nomogram offers two methods of solution in each instance. In one, the answer will appear on either the form or full scale of the nomogram, *Fig.* 3. In the second case, the complement of the angle will be found on the other scale.

designed for
PRODUCTION

HORIZONTAL BAND MACHINE
designed for heavy stock removal

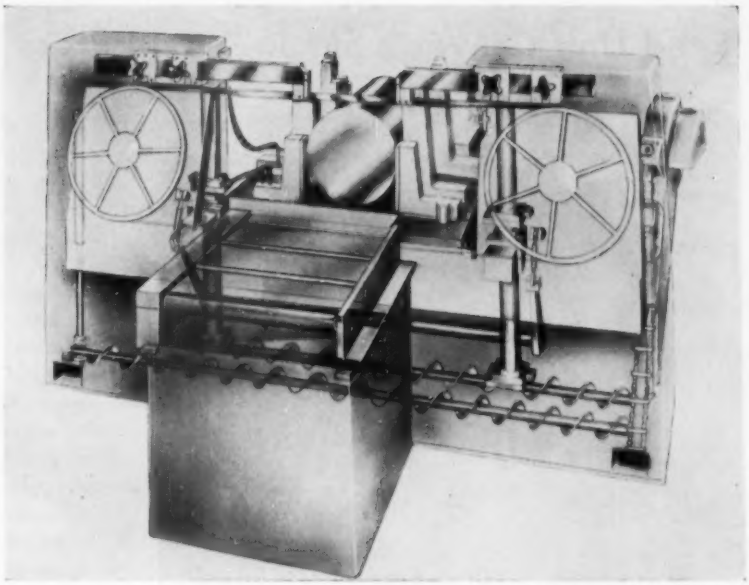
Using the top portion of the exposed saw band, a heavy-duty power saw developed by The DoAll Co. is capable of accurate cutoff with low material waste. The rigid design uses a two inch wide HSS band, operating at speeds from 20 to 200 fpm.

Controls for the variable speed drive are in a movable console. This enables the operator to view the work without having to leave the control station. Feed controls, a tachometer and the infinitely variable speed permit him to monitor the operation for maximum cutting rates and saw life. From the console, the operator can also raise hydraulic lift rollers during load and unload of the machine. Located between the standard rollers, the lift rollers will clear the vise bed by one inch to facilitate the movement of work into position even when the work is slightly warped.

Driving power and the control system are supplied by two independent hydraulic systems. The main drive consists of a variable delivery pump that supplies power to a fluid motor directly coupled to the driven saw band carrier wheel. The secondary hydraulic system regulates the saw feed through cylinders at each end of a U-frame. A torque tube linkage insures undeviating movement of the U-frame on lubricated vertical ways.

—Photo courtesy The DoAll Co.

THIN SECTION cut from a heat-treated steel alloy I-beam in 2.3 minutes. Accuracy was better than $\frac{1}{32}$ inch flat and square.



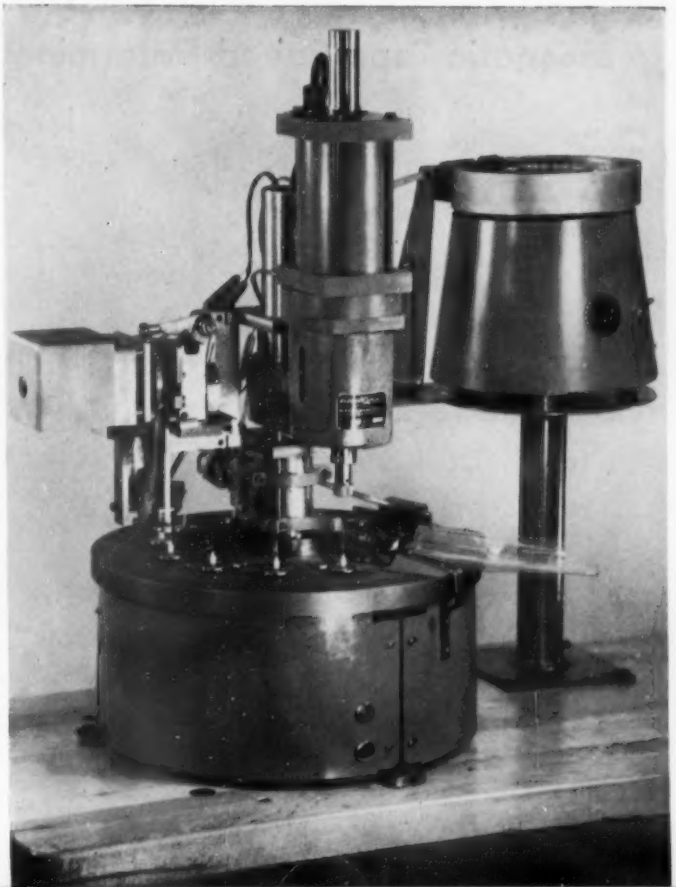
—*Photo courtesy The DoAll Co.*

CONSTRUCTION DETAILS of the horizontal band saw. Vise jaws are located on both sides of the saw in this model to permit sawing of both ends of a billet without removing the workpiece from the machine. A built-in chip conveyor system clears away the chips, thoroughly drains them and discharges the waste material into suitable containers.

Hypodermic Needles Assembled Automatically

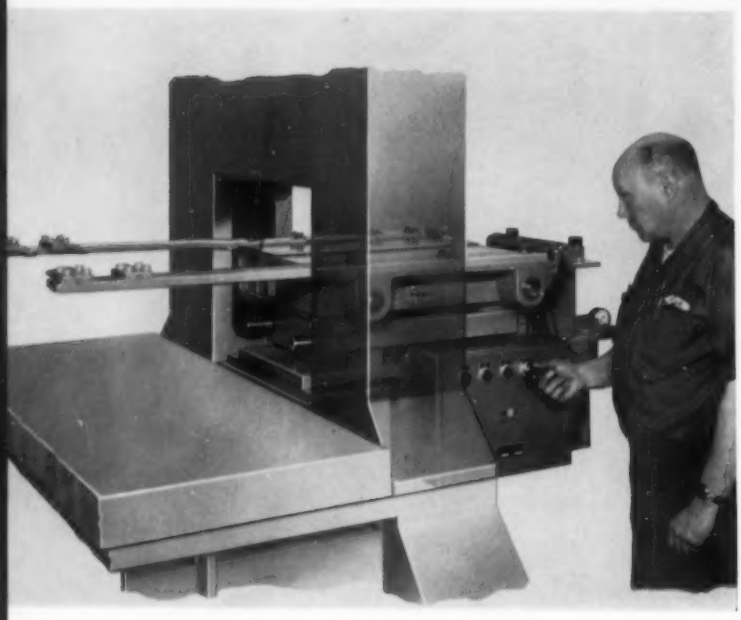
An automatic machine to feed, assemble and swage disposable hypodermic needles has been developed by Black & Webster, Inc., of Newton, Mass. During the operation, aluminum hubs are fed from a vibratory feeder, down a plastic tube to an orienting mechanism and escapement. The hub is correctly positioned, dropped on an anvil and carried to a cannula-feeding station. When the cannula is positioned in the hub, the parts are swaged and the finished assembly is ejected automatically.

The impact tool for the swaging is operated by a d-c solenoid as well as furnishing the power for the operation. The tool is actuated by the indexing cam in the table and is synchronized with it. The table must be locked before the punch operates. Other interlocks prevent machine operation if defective parts are fed into the system.



DESIGNED FOR PRODUCTION

Feed Unit Converts Single-Action Press to Transfer Press

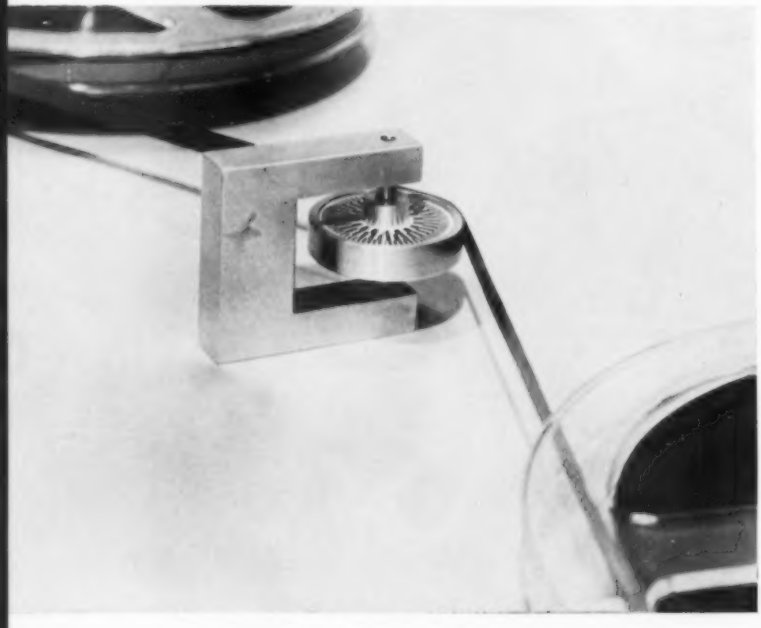


Conversion of any single-action press into a transfer press is facilitated by a feed unit that is bolted to the press bolster plate. The unit, developed by Press Automation Systems, Inc., of Warren, Mich., can feed material between dies in one press or transfer feed two or more.

Air cylinders operate through ball-bearing linkages to control all movements of the unit. In a typical operating sequence, gripper fingers on parallel horizontal arms move toward each other to pick up the part. The arms advance the part into the next die or station. At this point, the part is released and the arms retract to start position.

An interesting feature of the unit is the control panel mounted on the side of the unit. A plug in the side of the panel permits the press controls to be joined electrically with the feed unit and have it operate in sequence with the press.

Magnetic Tape Speed Determined by Rotating Wheel



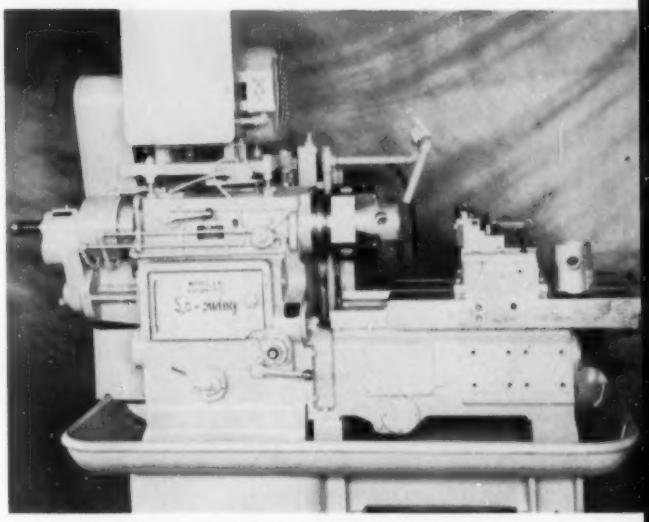
A 60-cycle power source and ordinary light bulb furnish the basic timing for an inexpensive, stroboscopic device for determining the speed of magnetic tapes. The device, produced by the Scott Instrument Laboratories of New York, is essentially a wheel with stroboscopic markings which is placed against the moving tape to indicate tape speed.

If the pattern on the wheel seems to stand still, the tape is on speed. If it seems to turn slowly backward or forward, the tape is off speed and the operator must adjust the capstan speed.

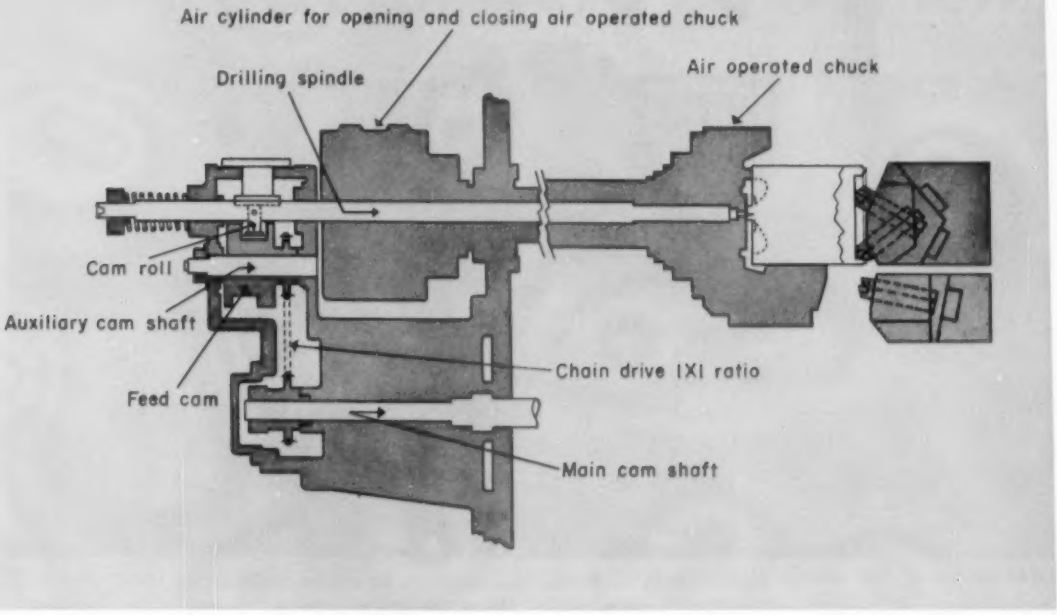
Combined Operations Improve Accuracy

To eliminate a separate operation of center drilling aluminum pistons, a special tooling arrangement permits drilling through the spindle while the workpiece is being bored, faced, turned and chamfered. Perfect alignment between the center drilling and skirt boring is assured because both operations are done simultaneously.

The operation is accomplished by having a cam-driven, spring-loaded drilling spindle connected directly to the main camshaft of a Seneca Falls lathe. The center drilling spindle is in a retracted position when the piston is mounted in the chuck. As soon as the main camshaft is engaged to begin the machining operations, its rotation is transmitted through a chain drive to the auxiliary camshaft. Rotation of the auxiliary camshaft is translated into linear motion by a cam roller in the feed cam groove. The cam roller is keyed into the drilling spindle shaft. As the feed cam turns, the roller forces the drilling spindle forward to drill the center as shown in the schematic drawing.

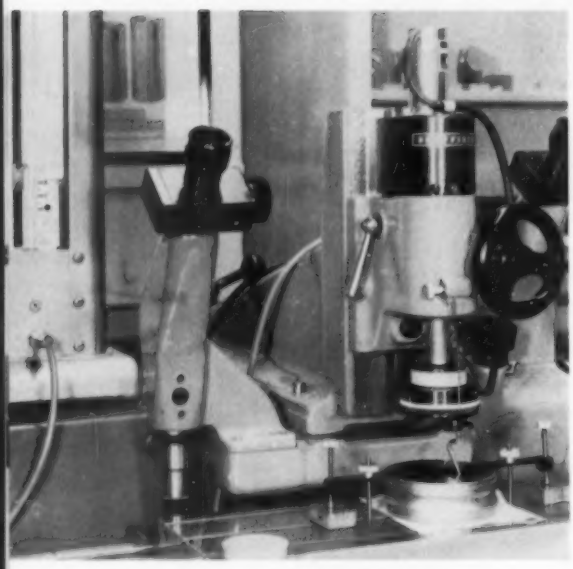


LATHE with cam-operated center-drill spindle for machining centers in aluminum pistons. The workpiece is held in the air-operated chuck during the operation.



SCHEMATIC DRAWING of components in the lathe for combined machining operations. Main cam shaft drives the auxiliary cam shaft by roller chain to operate the drilling spindle.

Checks Hole Location and Roundness



To obtain accurate measurement of hole location as well as to detect out-of-roundness or contour deviations in precision parts, the Sandia Corp. uses a motorized Sheffield air gage unit on a SIP universal measuring machine. Any deviation from roundness of the bore is detected by the slowly rotating stylus. Variations are indicated by movement of the float in the air gage column.

Hole position is obtained by reading the relative location on coordinate scales in the two microscopes. These readings are taken after the hole center has been precisely determined by the gage unit.

CLOSE-UP of the gaging head and tramming unit. Microscopes for reading the coordinate positions are located at the sides of the gaging head.

GAGING SYSTEM for precise measurements by tramming the gaging stylus. Speed up to 50 rpm are obtained by dialing the desired level on the unit in the foreground.

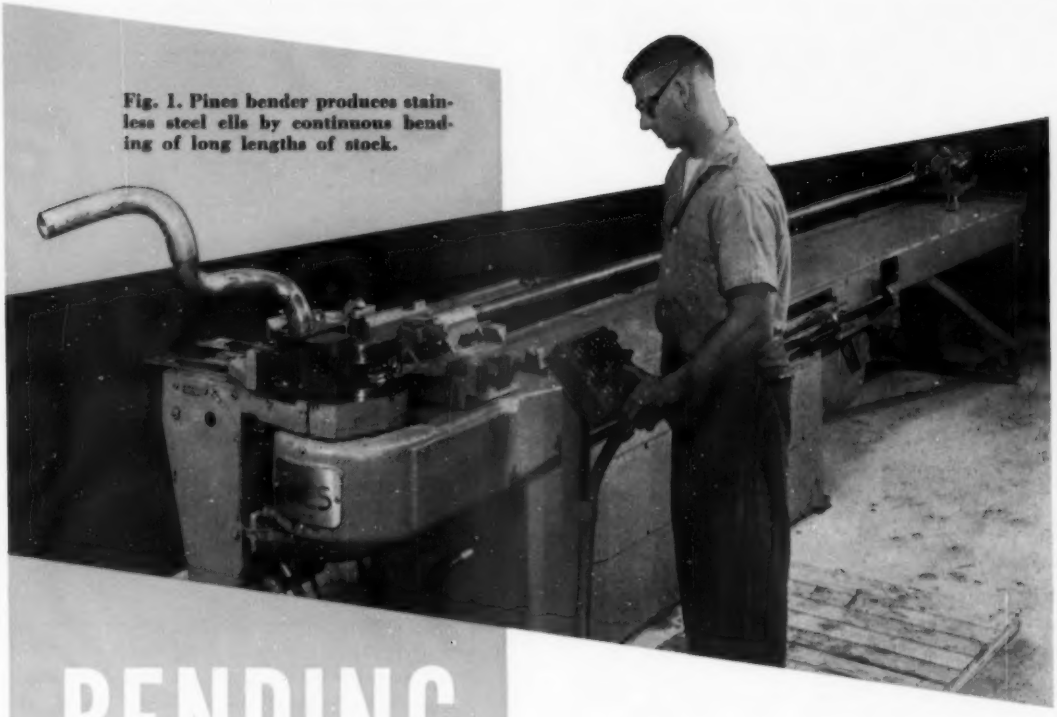


Fig. 1. Pines bender produces stainless steel ells by continuous bending of long lengths of stock.

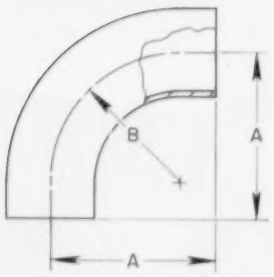
BENDING Small-Radius Ells ...with standard equipment

By Don Juleen
Plant Superintendent
Alloy Products Corp.
Waukesha, Wis.

Continuous bending of stainless tubing ells is accomplished on a conventional bending machine using special tooling. Costs have been reduced and production increased on a number of standard fittings.

FABRICATION OF TUBULAR PRODUCTS for the dairy industry requires production of large quantities of small radius stainless steel ells. Radii of less than twice the tube diameter are required. Previously, precut lengths of tubing were filled with a low-melting temperature bismuth alloy and extruded through dies on a ram type press. After extruding, it was necessary to trim between 1 and 1½ inches of tubing per end from the precut lengths of stock. Production averaged 30 pieces per hour. Scrap losses from trimming were high. Since stainless tubing in 2½ inch OD by 0.065-inch wall thickness, for example, costs approximately $3 per foot, trimming was costly.

Early in 1957, tooling developments in bending machines made possible the forming of stainless steel tubes with radii of less than twice the tube diameter. One such bender, *Fig.* 1, is producing



Standard Tubing Ells

OD (inch)	A (inch)	B (inch)
1½	2⅞	2 3/16
2	3 23/32	2 31/32
2½	4 27/32	4
3	5 29/32	5

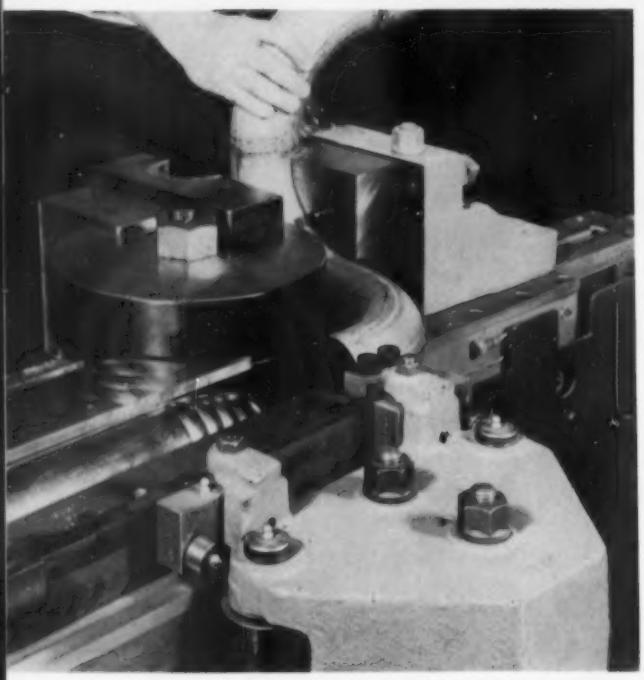


Fig. 2. Typical tooling setup for producing all sizes of bends. Tools clamp on previous bend section. Sliding pressure die shown in foreground moves with tube during bend to prevent marring. Wiper die supports inner wall of tubing and, with cable type mandrel, smooth, small-radius bends are produced without wrinkles.

stainless steel ells in sizes from 1½ to 3-inch OD. Wall thicknesses are from 0.050 to 0.065 inch. Production rates are more than four times faster than with the previous method. In addition, scrap losses have been reduced. Ells are currently being produced at speeds between 100 and 150 per hour. Of greater importance is the fact that only ¼ inch of material per end is lost in sawing and trimming operations.

With special tooling 90-deg ells are formed in a continuous series of bends, from long stock lengths. Fifteen parts are obtained from a 10-ft length of 2½-inch OD tubing having a 0.065-inch wall thickness. Individual ells are produced by sawing the bent tube apart at proper intervals. Two cuts are taken with a ⅛-inch wide saw. The first cut is a roughing cut to separate ells and second cut is used to square off ends to size.

Tooling used to produce the continuous series of bends, all on radii of less than twice the tube diameter, includes a bending form with compound section, a cable type mandrel, a wiper die and a compound clamp die with a cleat in the horizontal groove, *Fig.* 2. The cleated section of the clamp die and an opposed cleat in the bending form are used only for the first bend in each length of stock. The cleat makes it possible to bend with a short clamping area. After the first bend is made, all succeeding bends are made by turning the tube 90 degrees counterclockwise to locate the previous bend in a vertical position in the compound dies. Clamping on the preceding bend prevents slipping and helps to eliminate marks on the tubing. This helps to further reduce scrap losses. The mandrel, as well as the inside of the tubing, is swabbed with a heavy oil prior to bending.

Standard bends are shown in the accompanying table. In spite of the small centerline radii, good bends are produced. Springback is easily controlled by adjusting the degree-of-bend setting on the machine. There is no necessity for reworking tools. Also, tool changes from one size to another are accomplished in less than one hour. This reduction in time is an advantage since production runs average about 2000 pieces per setup. The success achieved so far in applying the cold-bending method to a few fittings can be equally well applied to the production of many other sizes of fittings currently being manufactured.

References

"Physical Properties of Bent Tubing," THE TOOL ENGINEER, March 1957.

Springings, W. J., "Cold Forming Improves Tubular Parts," THE TOOL ENGINEER, July 1957.

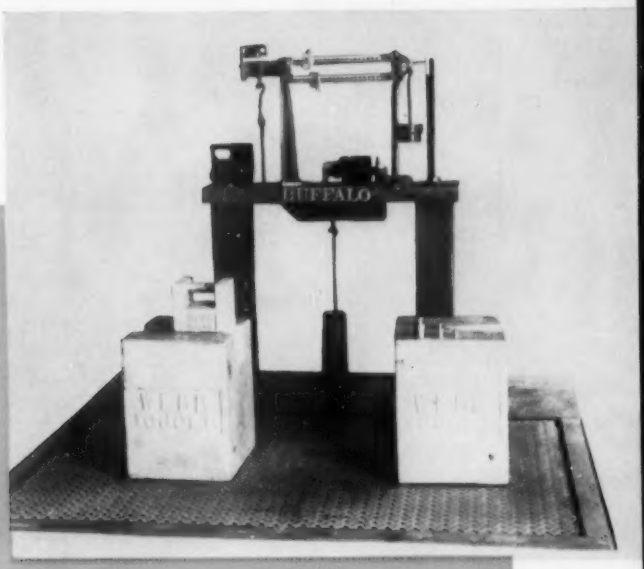


Fig. 1. Commercial platform scale, modified for extremely precise measurements of large masses.

PRECISION WEIGHING *with platform scales*

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Reading systems of platform scales can be modified so that differences in mass as small as 1/3 oz can be observed when comparing unknown weights against calibrated standards.

PRECISE DETERMINATIONS of weight are becoming increasingly important in many fields. There is a growing practical need for fast, accurate and low-cost weighing equipment that can accommodate large loads. The equal-arm balances ordinarily used in missile and space vehicle work are slow, expensive, and limited in capacity to about 56 lb. Commercial scales of the weigh beam type, when used in the conventional manner, are not capable of a high degree of precision, primarily because their weigh beams are usually graduated in divisions no smaller than ¼ lb and because the weigh beams cannot be centered exactly in the trig loop. Consequently, small changes in the condition of balance of these scales cannot be detected.

Still other sources of inaccuracy are discrepancies in lever ratio and improper adjustment of counterpoise weights. The consequence is that a commercial platform scale with a capacity of 500 lb can be expected to produce errors as large as 8 oz in direct weighings. The errors of scales with larger capacities are proportional.

It is possible, however, to modify the reading system of a platform scale, *Fig.* 1, so that very small differences in the weight of two masses can be observed. By comparing unknown weights against calibrated standards of mass, differences as small as ⅓ to 2 oz (depending on scale capacity) can be detected. In practice, the weight under test is first balanced on the modified scale. Then the weight is removed, and the balance condition is duplicated with calibrated standards. This technique avoids completely the causes of inaccuracy listed and gives the platform scale a capacity for considerable precision. It should be noted that to achieve the degree of accuracy mentioned, the scale should meet the specifications for commercial scales outlined in NBS

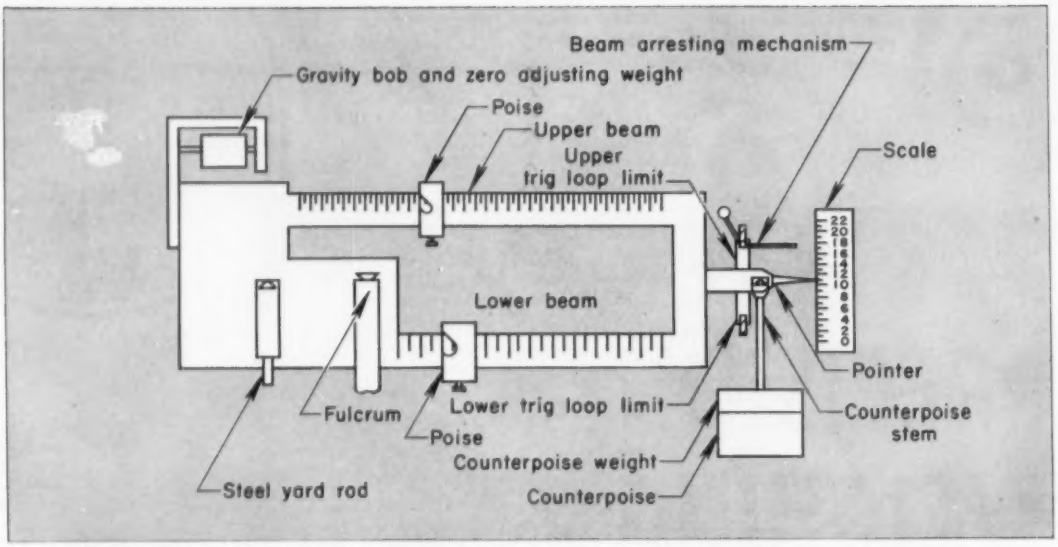


Fig. 2. Weigh beam with modified reading system.

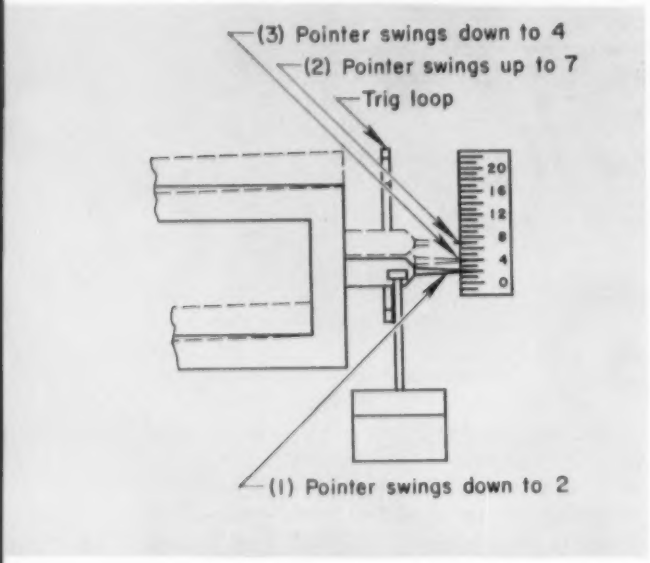


Fig. 3. (left) Swing of pointer when platform is loaded with 1958 lb of calibrated standards.

Handbook H-37, *Testing of Weighing Equipment.*

The necessary modification to the reading system consists of a pointer attached to the counterpoise end of the weigh beam and a stationary scale across which the pointer moves when the weigh beam oscillates, *Fig.* 2. The pointer may be attached in any manner that does not interfere with the movement of the weigh beam or the counterpoise. The scale should be long enough to cover the maximum swing of the pointer, should be graduated in units of at least $\frac{1}{16}$ inch, and should be fixed to a bracket mounted to a stationary member of the scale. The bracket should be capable of being easily adjusted so that it may be positioned in relation to the pointer. Since attaching the pointer to the weigh beam is equivalent to adding weight to the counterpoise, the scale must be readjusted to zero balance after the pointer has been mounted.

Before actual weighing, the sensitivity of the modified scale must be determined. The platform is loaded to about one-half capacity with the weigh beam locked. The weigh beam is then released, and the scale is brought to a condition of balance that permits the weigh beam to oscillate in the trig loop without touching the limits. The poise is next locked in place. At least three consecutive turning points of the pointer are recorded during oscillation, two at one extremity of the swing and one at the other. The rest point is obtained by adding the average of the two readings at one extremity to the reading taken at the opposite extremity and dividing this sum by two. With the poise and counterpoise weight left undisturbed, a small known weight (usually 1 or 2 oz) is added to the weight already on the platform and the new rest point determined.

The sensitivity of the scale per scale division is found by dividing the added weight by the number of scale divisions between the two rest points. For example, if the addition of a 2-oz weight produces a change of four scale divisions in the rest points, the sensitivity is 0.5 oz per scale division, at one-half scale capacity. The qualification is necessary because sensitivity may vary slightly with load. The sensitivity of scales equipped with a gravity bob on the end of the weigh beam opposite the counterpoise may be adjusted by raising or lowering the bob.

The technique for weighing an object on a modified scale is as follows: With the weigh beam locked,

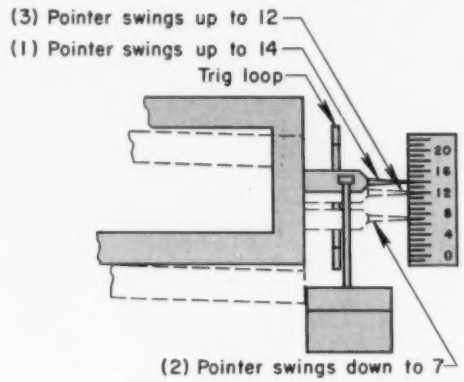


Fig. 4. Swing of pointer when a 2-oz weight is added to the 1958 lb of standards on the platform to determine sensitivity.

the object is placed at the center of the platform. The weigh beam is released and the scale is balanced so that the weigh beam oscillates within the trig loop. The poise is then locked in position, and neither it nor the counterpoise weight is changed during the remainder of the weighing. The rest point (R_1) is next determined.

When the weigh beam has been arrested, the object under test is removed from the platform. Enough standards of mass are then placed on the center of the platform to restore approximately the previous condition of balance, so that the weigh beam again swings free in the trig loop. The new rest point (R_2) is determined. Sensitivity is next found by adding or removing a small weight of known value. This operation is necessary because of the variation of sensitivity with load previously noted. After repeated use of the scale with various loads, this variation in sensitivity will, of course, become known. Finally, the difference between the two rest points (R_1 and R_2) is multiplied by the sensitivity per scale division factor. The resulting value is then either added to or subtracted from the sum of the standards used to give the true weight of the object.

In order to make the method perfectly clear, a step-by-step example will be given.

1. An object is placed on the platform and the scale brought to balance. For the calculations, the position of the poise and the weight on the counterpoise are ignored. The pointer swings consecutively down to 4, up to 10, down to 6. Rest point R_1 is:

$$R_1 = \frac{1}{2}\left(\frac{4+6}{2} + 10\right) = 7.5$$

2. The object being weighed is replaced by standards totaling 1958 lb to duplicate approximately the first rest point. The pointer now swings down to 2, up to 7, down to 4, as shown in *Fig.* 3. Rest point R_2 is:

$$R_2 = \frac{1}{2}\left(\frac{2+4}{2} + 7\right) = 5.0$$

3. Sensitivity is found by adding a 2-oz weight to the platform. This addition causes the pointer to swing up to 14, down to 7, up to 12, as shown in *Fig.* 4. Rest point R_3 is:

$$R_3 = \frac{1}{2}\left(\frac{14+12}{2} + 7\right) = 10$$

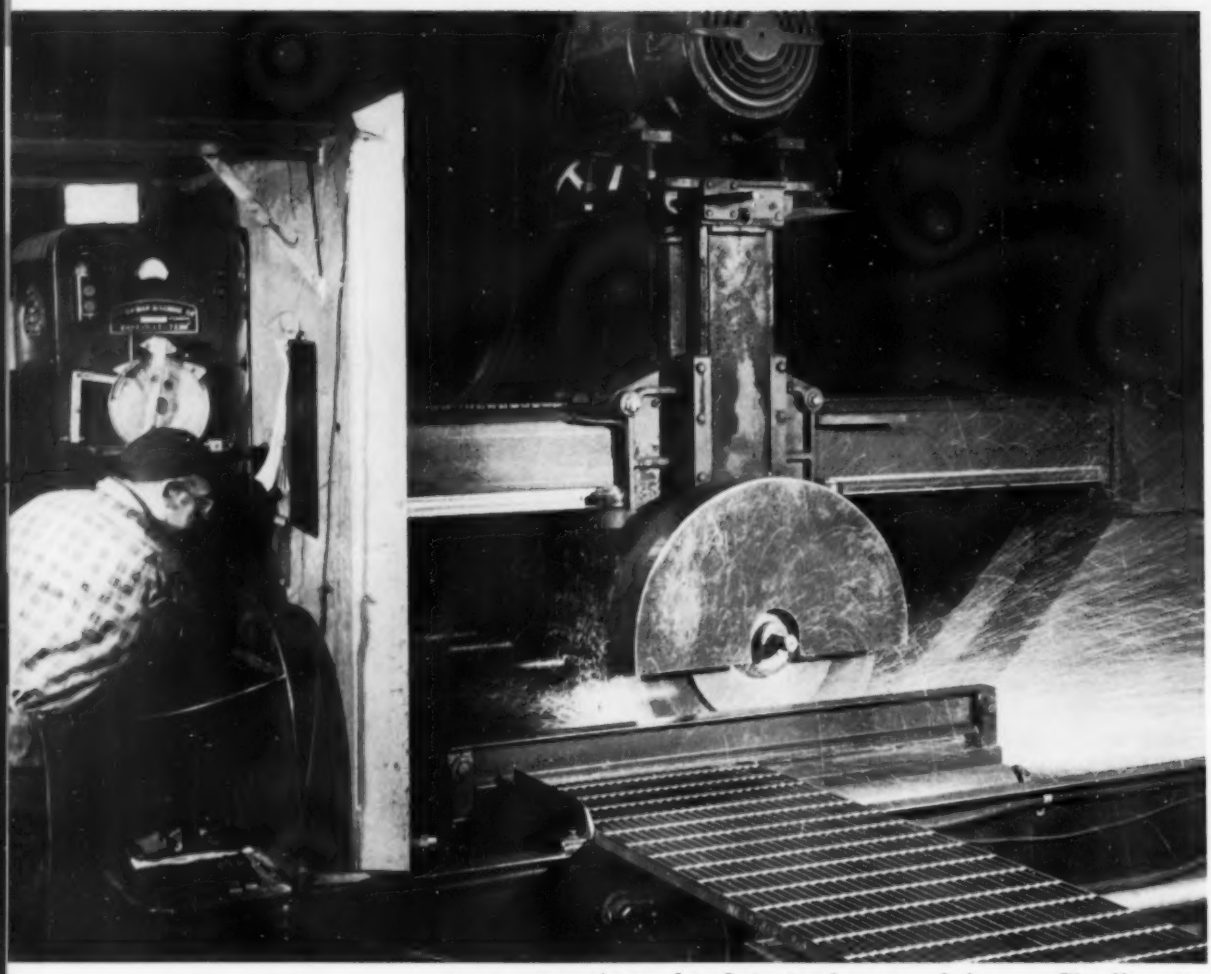
The sensitivity, found by dividing 2 oz by $R_3 - R_2$, is 0.4 oz per scale division.

4. The difference in weight between the object under test and 1958 lb is next calculated. Rest point R_1 produced by the object under test is 7.5 lb. Rest point R_2 produced by 1958 lb is 5.0 lb. The difference in rest points is 2.5 lb. The difference in weight is then 2.5 scale divisions times 0.4 oz per scale division, or 1 oz.

5. The final weight may now be found. Since R_1 is greater than R_2, the weight under test is heavier than the standards, heavier by 1 oz or 0.06 lb. The weight of the object is therefore 1958.06 lb. The weight of any container or vehicle used to support the object being weighed can be disregarded in the calculations, provided, of course, that it remains on the platform during all of the rest point determinations.

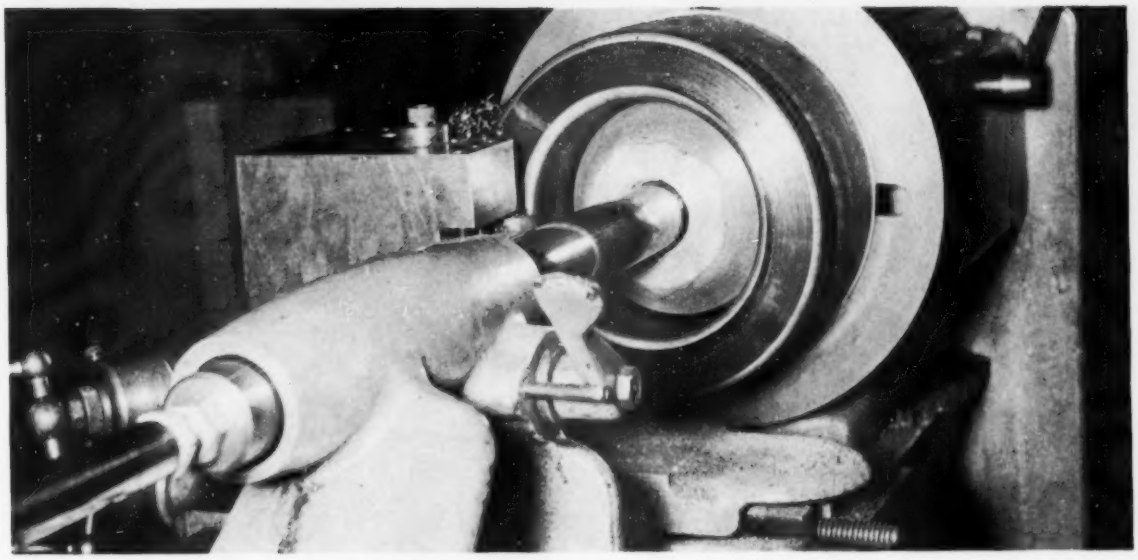
From this discussion it is easy to see that the accuracy of the method stems from the fact that the scale itself is used only as a comparator. That is, the only requirement is that the scale be able to duplicate its position when subjected to equal loads. When this ability exists, the accuracy of weighings depends solely upon the ability of the operator to read the scale and upon the accuracy of the standards of mass used in the operation.

"That isn't what I meant by a closer scheduling of production, Hawkins, and it certainly isn't speeding things up!"

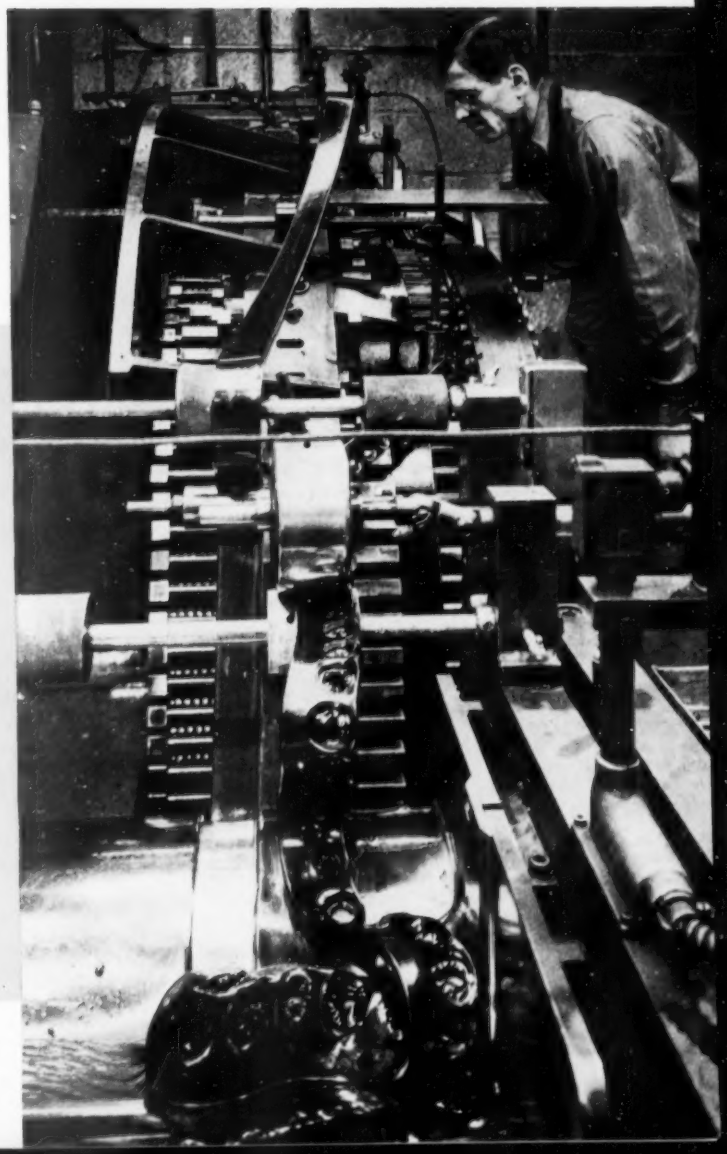


STEEL GRATING is sawed to fit intricately patterned shapes at Blaw-Knox Co. Saw cuts gratings up to three feet wide, and from ¾ inch to 2¼ inches thick.

TOOLS at work



HIGH-SPEED FACING and chamfering annular surfaces on cold-drawn steel cover plates is completed in ten seconds at Davis-Martin Engineering, Inc. Quick-acting holding fixtures prevent distortion or marring which results from conventional chucking. The workpiece fits onto a wooden fixture bolted to a faceplate. A hydraulic ram on the tailstock holds the part in place during machining. Kennametal Grade K7H carbide inserts are used.



FULLY AUTOMATIC continuous process for custom molding rubber parts in production at The Ohio Rubber Co. Each part is formed in a self-registering single-cavity mold, which affords high precision. The operator keeps the machine supplied with stock and removes containers of finished parts. The stock is loaded onto plasticizing rolls, from which it is fed onto the rotary molding portion of the machine. Individual molds mounted on a rotating wheel take the amount of material they need, carry it through the molding and curing stages, discharge the finished part and return for more stock in a continuous cycle. One machine can produce from 40,000 to 200,000 pieces per day depending on the material and the size of the piece.

LOW WEIGHT of wind tunnel test models of urethane foam permits wide experimentation in distribution of mass. Models used at Chance-Vought Aircraft, are easily weighted where needed to study effects of inertial distributions. For minimum wind resistance, models are built with an epoxy skin. The open mold is lined with glass cloth and epoxy resin laminate. Plastic poured into mold foams around a wood or metal skeleton.

VISCOUS URETHANE FORMULATION is poured into mold half. Mold is then closed and clamped. Foam cures in less than one hour, filling all cavities. Models are used to test wings, bodies, and tail sections for flutter and vibration under simulated flight conditions.

TOOLS at work

MODEL PILOT escape capsules and droppable fuel tank models are inspected after stripping foam molds. Models are less expensive and stronger than those made of balsa wood. Urethane formulations are supplied by Minnesota Mining & Mfg. Co., and Emerson & Cuming, Inc. Diisocynate raw material is furnished to formulators by National Aniline Div. of Allied Chemical & Dye Corp.

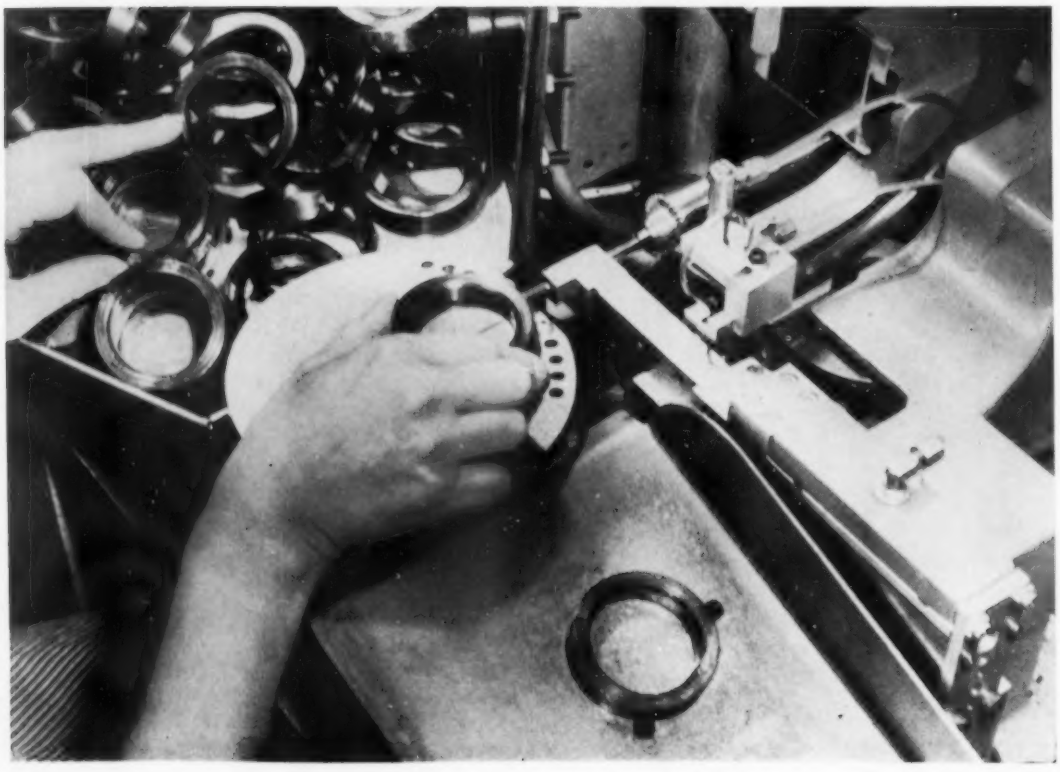
FORTY-FIVE DIFFERENT SHAFTS in lots of 10 to 300 pieces, plus many "specials" involving two or three of a kind, are produced interchangeably with this tracer machining setup at Hobart Brothers Co. The shafts, used in motor-generator sets, are up to 72 inches long and are turned with carbide cutters from 1045 steel. Because the shafts differ principally in length, setup time and template costs are reduced by using a sectional template arrangement. Various middle sections are inserted between standard end patterns to obtain desired shaft lengths and shoulder locations. To cut machining time, shoulder necking operations are eliminated by using a 55-deg stylus and similarly shaped cutting tip. Production on a single Warner & Swasey 2A lathe with tracer cross slide equals the output obtained formerly from two saddle type machines. Setup time is one sixth.

HYDRAULIC PRESS BRAKES with progressive dies coupled with an automatic material feeding system are used to form major components of automotive seat frames at each stroke of the press. In a one-man operation, the first press stamps and forms the rear rail from material fed through a nine-station progressive die from the back of the press to the front. The second press equipped with two four-station dies, flattens and forms the ends of tubular material used for front seat split backs. Ram is held momentarily to distribute tonnage as the punches enter. Press brakes, manufactured by Pacific Industrial Mfg. Co. are in operation at the Chicago Div. of L. A. Young Spring and Wire Corp.

OPERATOR LOADS SETSCREWS into automatic screwdriver at SKF Industries, Inc. The screws are inserted in pillow-block bearing assemblies. The machine handles eleven different diameter-to-length combinations—90 percent of the bearing work load.

TOOLS at work

WITH PRODUCTION RATES to 2500 per hour, the screwdriver cycles automatically in feeding and inserting screws as long as the operator keeps the foot pedal depressed. Operator feeds the lock collars manually, placing them against feed-table holding lugs for positioning. Machine was built by Standard Pressed Steel Co.



Steel-Rule Dies ...*for low-cost stampings*

By **Robert W. Reinhardt**
Assistant Editor

Steel-rule dies save as much as 80 percent of conventional die costs, yet have tool life and production rates comparable with higher cost tooling. Case studies and production data illustrate the effectiveness of the process in diversified fields such as missiles and appliances.

MANY INDUSTRIAL PROJECTS have been rejected because the cost of tooling exceeded the economic value of the product. One answer to the problems of expensive tooling or the high cost of prototype work, at least with reference to stampings, is the use of steel-rule dies.

These tools are not new to industry because similar ones have been used for many years in paper products manufacturing for cutting and folding operations. Such items as cartons, cloth, gaskets, fiber boards and plywood panels have been processed on them. In these cases only the upper portion of the die was used for the operations with a flat platen as the lower surface.

The application of the system principles to blanking and forming of metal parts is the newer aspect of this type of tooling, *Fig.* 1. Significant improvements in the original process, patented by Templet Industries, Inc., of Brooklyn, have extended the usefulness of steel-rule dies. On the basis of the patent, many manufacturers are now building and using steel-rule dies under license.

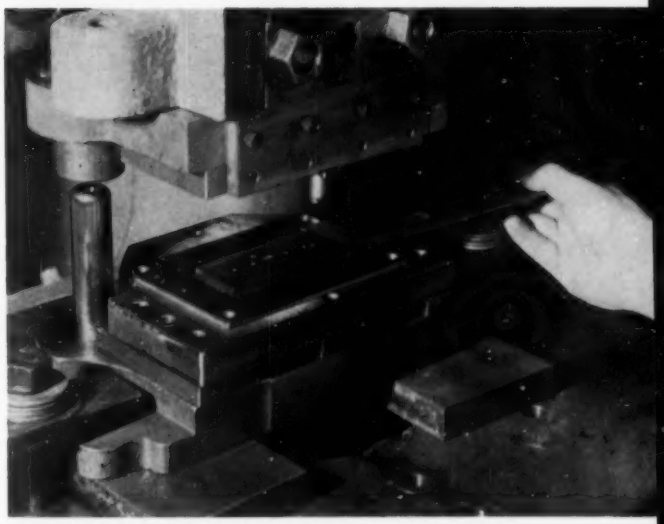


Fig. 1. Production stamping operation using a steel-rule die for perforating and blanking. Lower section assembly is a thin steel punch plate with rubber ejectors and is mounted on bolster plate in die set.

Die Description: Steel-rule dies consist of upper and lower sections similar to those in conventional dies. However, the punch is not located in the top portion of the die but is attached to an adapter plate on the lower, as shown in *Fig.* 2. Plywood is used for the top section to support and retain the thin band of steel, called the steel rule. Steel punches and inserts are used for piercing holes, sharp corners and special shapes. Ejectors for removal of blank and scrap are neoprene rubber.

Material for the upper section is usually seven-

ply hard maple with an epoxy binder. However, for many applications, a highly densified laminated compressed wood called Hy-du-lignum is being used as well as magnesium tooling plate.

Making Steel-Rule Dies: Among the advantages of steel-rule dies which facilitate manufacturing them is the elimination of the die design. Often, the die is complete before a conventional die could be designed. For a simple tool, a part print is usually the only drawing necessary. For a more complex part, an additional sketch by the tool engineer may be needed.

When making the die, the outline of the part and hole locations are scribed on the plywood panel using a height gage, *Fig.* 3. After completing the layout, holes for saw starting and for punches are drilled with a $\frac{3}{16}$-inch drill. To accurately spot the hole locations, a special drill bushing is positioned on the scribed center lines for the holes, as shown in *Fig.* 4. By use of a pilot plug in this location hole, holes for larger punches are drilled. For holes being punched that are less than $\frac{3}{16}$-inch diam, stepped punches are used.

Sawing of the part contour is done on a diemaker's precision jig saw, *Fig.* 5, with a blade that makes a kerf about 0.001 inch thinner than the steel-rule material. This kerf provides, in effect, an interference fit when the steel rule is driven into the plywood. Contour tolerances closer than 0.005 inch can be held by accurate sawing to the scribed lines. It is not uncommon for a skilled mechanic to hold 0.002 inch in sawing, using a magnifying glass on the saw. It is important in this operation to maintain a perpendicular position for the saw blade relative to workpiece, so that the resultant kerf is held within $\pm$ 0.25 deg.

Next step in the making of these inexpensive tools is the cutting of the steel rule and forming the soft steel to the contours of the sawed-out plywood block. Both operations are performed on hand-powered tools, as shown in *Fig.* 6. During bending, the wood block is used as the master for checking radii and contours. Typical bends are shown in *Fig.* 7.

After the steel-rule strips have been formed and heat treated, the pieces are driven into the kerf between the plywood outer section and contoured block. Straight sections are purchased heat treated to reduce assembly time. Prior to this operation, steel punches are inserted into the prepared holes in the block. To facilitate transfer of centers when making the lower section, the punches are made with conical points. In some instances, it is desirable to incorporate solid steel punches in the die where the contour is difficult to form with steel-rule strip or the part has excessively sharp corners. A punch of this type is being installed in *Fig.* 8.

Coating of the surface to protect the wood and the installation of neoprene inserts for stripping are the final operations needed to complete the upper half of the die. This half of the die is mounted in a special patented die set to transfer-mark the steel plate to be used for the lower section.

Making the lower section consists of mounting the $\frac{1}{4}$ or $\frac{3}{8}$-inch steel plate on the adapter plate and bluing it for the transfer operation. The outline of the upper section is transferred to the lower by striking it in the press. This marked plate is removed and the outline is rough sawed on a metal-cutting bandsaw. After rebluing the part, it is struck again with the top section. Final sizing is done on a filing machine and the proper clearances are obtained by removing all shear marks.

After hardening, the punch is remounted on the adapter plate. Rubber inserts are attached to the adapter plate to eject the offal during operation. Final operation is surface grinding to assure flat surfaces on both sections of the finished die.

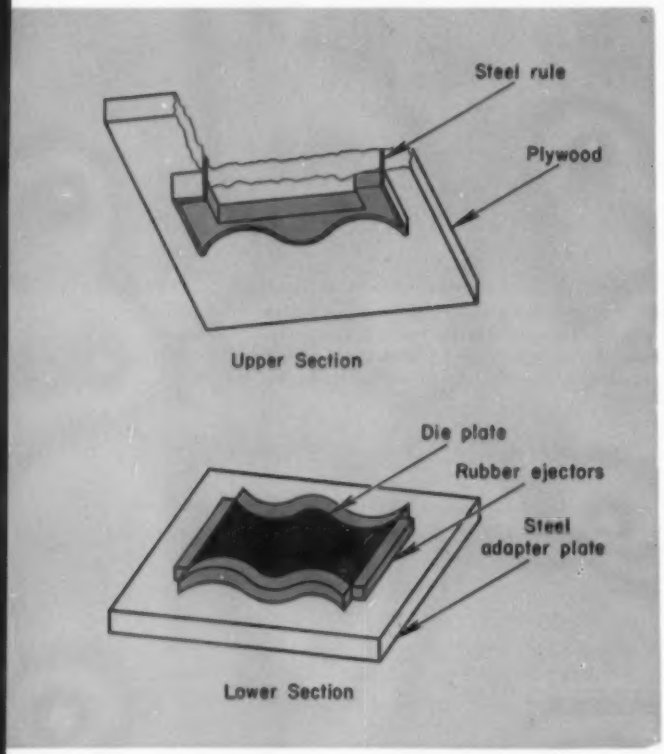


Fig. 2. Typical components of a steel-rule die. Rubber ejectors are mounted on both sections.

Fig. 3. Layout of a plywood section for a large die. Since plywood is not available in the proper size, two boards are used. Portable woodworking equipment machined cutouts for contours and punch heads.

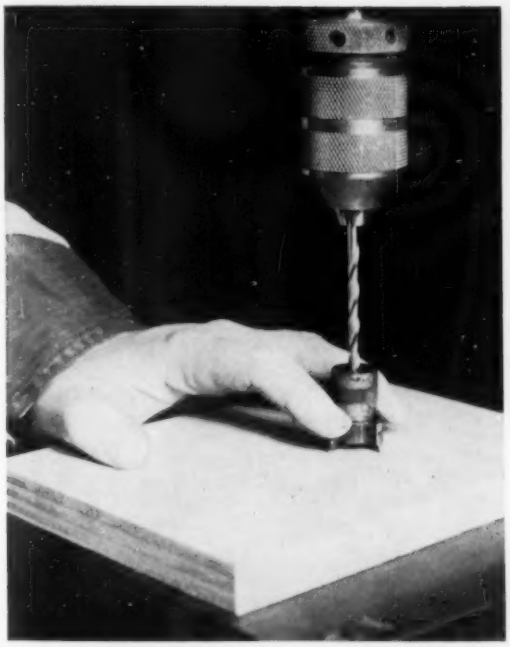


Fig. 4. Drilling holes using a special locator bushing to accurately position it on scribed center lines. For larger holes, a guide plug is used in the drilled holes to position the larger drill.

Heat Treating Steel Rule: Steel rule is purchased in either hard or dead-soft state, and must be hardened to extend the life of the die. Hardening is generally done by the tool manufacturer in a small electric furnace. Temperatures range from 1450 to 1500 F for the hardening and the oil quench is maintained at 150 F. Temperature control may be effected by color which is red orange (1450 F) to orange (1500 F).

Tempering is done by replacing the rule in the furnace for about 30 minutes at temperatures of 600 F for extra-hard and 800 F for medium-hard parts. Workpieces are cooled in still air at room temperature.

Best results are obtained in heat treating steel rule if the pieces are kept as short as possible to prevent distortion. To reduce possibility of distortion, the rule should be placed in the furnace so that it can stand on the back edge. Parts should be quenched immediately when taken from the furnace and agitated in the bath during the quenching operation for uniform hardening.

Calculating Press Requirements: Procedures for the determination of the proper press size for conventional dies are also satisfactory for steel-rule dies. Total shear area is multiplied by the unit shear resistance in psi to give the maximum pressure required for the operation. Generally, the limitations on the size of die used in this process is the physical size of the press bed rather than the tonnage. Oversize bolster plates are used to extend the press beds on equipment using steel-rule dies.

Estimating Die Costs: Based on experience, it has been found that costs of steel-rule dies can be easily calculated. Straight sections in the die cost about five dollars per linear inch, while curved sections are figured on a basis of ten dollars per linear inch. Round holes cost ten dollars each and irregularly shaped holes about fifteen dollars each. Various special conditions such as large solid punches or inserts will alter the final calculations.

Users of the process are claiming die costs have been reduced from 70 to 90 percent, compared with the cost of conventional tooling. Also, procurement time has been reduced from 70 to 80 percent. On the basis of these savings, some plants are considering the use of these dies to replace some conventional tools. As an example, one large manufacturer purchased a steel-rule die for $105 to replace a conventional die costing $1450. In addition, the die was made in one day, whereas the conventional die would require six weeks to complete.

Application of the Dies: Stampings produced on steel-rule dies are being used on products as varied as missiles, refrigerators, electrical appliances, automobiles, aircraft and toys. Operations include piercing, mild forming, mild extruding, shearing and notching, in addition to blanking. Most of the conventional materials, such as magnesium, aluminum, titanium, mild steel, alloy steel and stainless steel, have been used to produce parts by this process. In addition, heavy paper, plastics, cloth and plywood are among the various materials being processed through steel-rule dies.

While 100,000 pieces is generally considered the expected life of these dies for steel parts, one company has produced one million parts without having the die wear out. The only parts needed to be changed were the rubber ejectors which fatigued from the continual pounding.

In an experimental plant, steel as thick as 1⅛ inch has been successfully blanked on a die designed for parts less than ¼ inch thick. This die with metal-to-metal contact has been used to produce parts ranging from 0.002-inch gasket material to the part just mentioned. Thus, it appears that the steel rule die tends to seek the least line of resistance when blanking the heavier materials. It has been theorized that the deflection of the steel rule was sufficient to establish the proper clearance. Hence, the proper shearing and break on the part were obtained.

In a plant producing electrical appliances, production of 80,000 television cabinets was made on a steel-rule blanking and lancing die. At the end of production, the die was removed from the press and within one day changed for a new model, then returned to production. Blank size is about 48 x 30 inches, and the material used on the part is vinyl-coated aluminum. This plant has over 200 dies in current use with additional tools being contemplated for new models. Management at this company considers the savings to be about 73 percent over the conventional tools, but more important is the time saved in change-over to a new model.

In another case, an automotive manufacturer has used a steel-rule die on a limited production job for the entire output at substantial savings. Twenty thousand parts were produced at a normal rate of production on a die that cost less than 10 percent of a conventional die. Another division of the same company has produced about 85 dies at slightly less

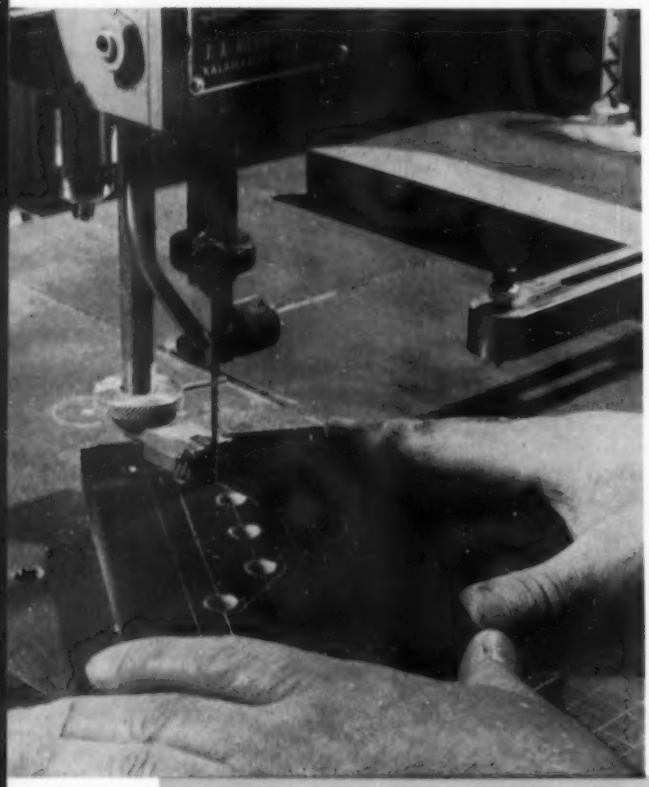


Fig. 5. (above) With layout as guide, contour is sawed on a diemaker's jigsaw. Saw blade is thinner than steel rule to obtain a drive fit during assembly.

Fig. 6. (right) After shearing to desired length, rule is bent to the proper contours.

than $13,000, including 50 parts for tryout. Completion of the tools required less than three months.

Continued use of steel-rule dies by industry will encourage the development of other techniques to increase the productivity of the stamping operation. Currently, the normal equipment found in the press-room is being used in conjunction with these dies. Such items as roll feeds, pin guides and even accessory stripper plates are used on high-production.

Productivity of a major appliance manufacturer has so improved with these tools that 25 percent of the presses formerly needed for conventional dies have been sold. Since it is not necessary to remove die sets from the press, down time during die change-over is reduced, resulting in an increase in productive output of the equipment.

Special Refinements: At this same plant, production of a large panel has exceeded 200,000 units on a die which was equipped with a positive knockout system instead of the usual neoprene inserts. The initial part stamped on the die was used as the stripper. Clearance was filed around the edge of the part and Belleville washers were used as springs. A rule, about 1¼ inches high, was used to obtain sufficient clearance for the washers to get better ejection of the blank.

Another adaptation of the positive knockout is obtained by gluing the first piece on the rubber inserts. When using this type of ejection, it has been found that life of the rubber ejectors is increased. Also, flatter blanks are obtained, *Fig.* 9. Other typical dies are shown in *Figs.* 10 and 11.

Advanced techniques have been developed for holding the steel rule in the upper section of the die. These include the use of magnesium tooling plate and even sheet titanium where the life of the die is expected to amortize the additional costs. In another plant, plywood is being used but has been routed out in the area of the saw kerf so that steel inserts can be used to support the steel rule.

Many different methods have been developed to produce the steel punch used on the lower section of the die. One method employs the combination sawing of the plywood layout and a steel plate simultaneously. This process is reported to be saving much of the time spent in the shearing operation where workpiece tolerances are not critical.

On short production runs, it has been found that an aluminum plate bolted to the press bed forms a satisfactory lower section. In this method, the steel-rule upper section is imbedded into the aluminum plate, leaving a channel. While the tool performs for short production runs, the edge of the aluminum punch on the lower section tends to roll over, making it difficult to obtain acceptable parts.

To correct this undesirable characteristic, another method has been developed where titanium parts are blanked by the upper section by striking the rule against a flat plate. Then the blanks are stacked, doweled and screwed to the adapter plate. Again, better performance has been obtained on relatively short production runs.

Under normal plant conditions, it has been found

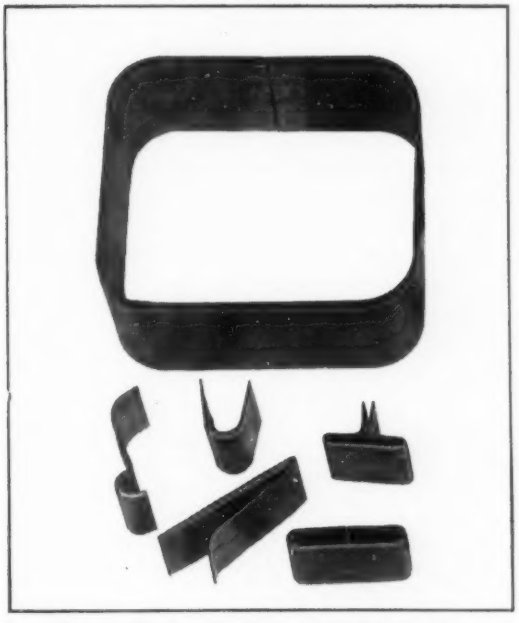


Fig. 7. Typical bends used in steel-rule dies.

Fig. 8. Solid steel punch being inserted for a special contour. Heads of standard round punches are shown before final positioning in the plywood panel.

Fig. 9. Two blanks produced in one hit on a steel-rule die. Positive stripper for offal is located on the lower die section. Thin trimming is shown on die set.

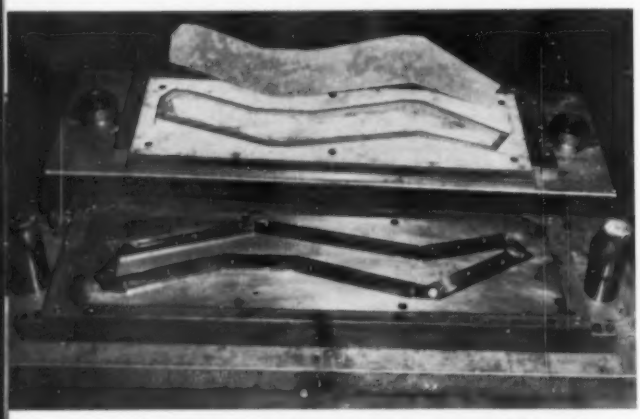


Fig. 10. Typical steel-rule die mounted in a die set. No stripper is needed on lower section because blank is large and easily removed.

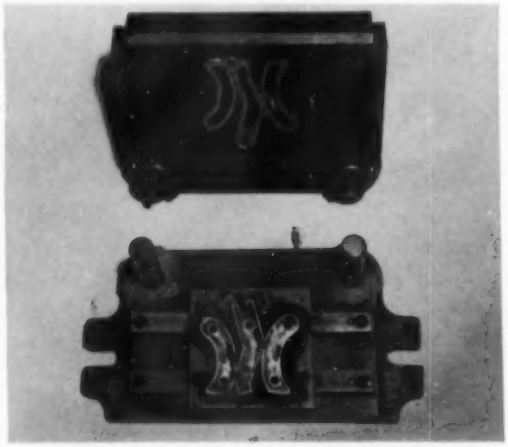


Fig. 11. Intricate blank and perforating die. Solid punch sections are mounted in upper section for blanking the slot and sharp corners.

that the plywood being used has a slight tendency to distort from changes in humidity. To correct this condition, one plant has installed an insulated room and a humidifier-dehumidifier unit to maintain ideal storage conditions. Savings to date on maintenance of more than 200 dies currently in use has more than paid for the installation.

Process Considerations: When evaluating the usefulness of this process, all the advantages and disadvantages must be carefully considered. The current thinking is that these dies are best suited for blanking parts to the normal, rather than close tolerances, for parts with simple, rather than complex, contours and for thinner, rather than thicker, materials. However, recent developments in materials and techniques have shown that steel-rule dies are not necessarily restricted so severely. Steel-rule dies for complex parts have been a source of considerable savings. Thicker materials are often easier to process than thin stock.

Steel-rule dies will not replace conventional dies on long production runs but will have a definite place in medium production, say up to 100,000 parts. For products that are changed yearly, the dies should prove useful for production of replacement parts where the storage of complete dies becomes a space problem.

They should serve well as stand-by dies for high production operations, thus eliminating the need for extra sets of regular dies. In addition, they could add extra capacity, if needed. These dies are particularly useful as prototype tooling to produce parts for blank development during the manufacture of form dies.

Short manufacturing time for the dies is a distinct advantage during development or the introduction of a new product. Other advantages that management should consider when evaluating the process are the ease of altering a die for design changes as well as the short period needed to train a technician to produce the dies. When expert diemakers are in short supply, the advantage of training personnel quickly can be the deciding factor in selecting steel-rule dies.

Acknowledgments

The helpful cooperation of William Eichelman of Templet Industries, Inc., Midwest representative, is greatly appreciated. Also, help of other individuals and companies has made this presentation possible. Some of this assistance came from:

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fabricating investment-cast cobalt-base alloys

COBALT-BASE ALLOYS in investment-cast form have properties that allow their use for a variety of applications where severe conditions of abrasion, wear, heat, corrosion and erosion exist. TABLE 1 lists four of these alloys and gives chemical compositions.

Alloy *B* is the toughest and strongest of this group of alloys. It has good impact strength, and is resistant to heat checking and thermal shock. Alloy *C* is harder and more abrasion resistant than alloy *B*. It will withstand moderate shock or impact. Alloy *A* was originally developed as a metal-cutting tool alloy. It is harder and has a higher compressive strength than either alloy *B* or *C*. Alloy D is the hardest of the group and has highest compressive strength. It can be used under moderate impact conditions.

Joining

The alloys in TABLE 1 can be joined to other materials by brazing and by welding. If the parts are to be brazed, the joining areas should be thoroughly cleaned, and then brushed with liberal amounts of brazing flux. Pieces of silver solder, 0.003 to 0.005 inch thick, cut slightly oversize, are positioned between the parts. The materials are heated to a cherry red color (1100 F) in an induction coil, a furnace, or with a slightly reducing oxy-acetylene flame. As soon as the silver alloy melts, the parts are moved from the source of heat and are placed in position for final joining. The assembly is then pressed together to squeeze out the excess flux and air cooled. Do not quench.

The alloys can be welded by oxy-acetylene, metallic-arc and inert-gas-shielded-arc methods. Preheating to about 1100 F is advisable before welding to avoid cracking.

Table 1—Chemical Compositions of Cobalt-Base Alloys

Alloying Element	Composition of Alloy Type (percent) A	B	C	D
Cobalt	Balance	Balance	Balance	Balance
Chromium	29.0-33.0	27.0-31.0	28.0-32.0	31.0-34.0
Tungsten	11.0-14.0	3.5-5.5	6.5-10.0	16.0-19.0
Iron	3.0*	3.0*	3.0*	3.0*
Nickel	3.0*	3.0*	3.0*	2.5*
Molybdenum	——	1.5*	——	——
Carbon	2.0-2.7	0.9-1.4	1.1-1.7	2.2-2.7
Manganese	1.0*	1.0*	1.0*	1.0*
Silicon	1.0*	1.5*	1.0*	1.0*
Others	2.0*	——	1.0*	2.0*

*Maximum

Machining

All alloys listed in TABLE 1 can be machined. In general, these alloys are machined with tungsten carbide tools. Tools for turning should have a 5-deg primary clearance, 10-deg secondary clearance, and a lead angle of 45 deg. Tools for facing and boring are essentially the same except for greater clearances where needed.

For best results in drilling, the drill web should be kept as thin as possible. In reaming, a 45-deg lead on the drill is desirable. Tapping is not recommended for any of these alloys.

TABLE 2 gives machining data that can be used as a guide in machining these alloys. The table has been modified to cover the machining of all the alloys and does not necessarily represent the optimum conditions for each. It should prove a valuable starting point, however.

Grinding

TABLE 3 lists grinding wheels and conditions that are recommended for cobalt-base alloys. The wheels noted are slightly softer than those for grinding high-speed steels. Wheel speeds recommended by the manufacturers should be used. These are usually between 2800 and 6000 fpm. The alloys can be ground wet or dry. Parts ground dry should not be quenched because checking may result.

REFERENCE SHEET

Table 2—Machining Investment-Cast Cobalt-Base Alloys

Machining Operation	Tool Material	Speed (fpm)	Roughing Feed (ipr)	Roughing Depth of Cut (Inch)	Finishing Feed (ipr)	Finishing Depth of Cut (Inch)
Turning	C-3 Tungsten carbide	30-45	0.008-0.015	0.040-0.050	0.005-0.008	0.010-0.025
Facing	C-3 Tungsten carbide	30-40	0.008-0.015	———	0.005-0.008	———
Boring	C-3 Tungsten carbide	20-30	0.006-0.013	0.030-0.040	0.003-0.006	0.005-0.020
Drilling	Carbide tipped or masonry type tools	20-30	———	———	0.002-0.005	———
Reaming	C-3 Tungsten carbide brazed inserts	25-35	0.005-0.012	0.040-0.060	0.004-0.008	0.015-0.018
Threading	C-3 Tungsten carbide	Use single-point tools. Internal threads up to ¾-inch diam can also be cut using single-point tools. Coolant: Undiluted cutting oil.				

Table 3—Grinding Investment-Cast Cobalt-Base Alloys

Type of Grinding	Wheels	Type of Work	Coolant
CYLINDRICAL			
Straight or tapered OD	A54-N5-V 19A150-K8-V 19A60-J-V	Sharp corners and fine finish Removing stock	1 gal soluble oil + 50 gal water + ½ lb alkaline metal cleaner
Form work, single wheel section method	A100-M-V FA100-L7-V	Sharp corner work Straight radius work	1 gal soluble oil + 50 gal water + ½ lb alkaline metal cleaner
Form work, crush-roll method	19A-220-L9-VG 19A150-L8-VBE		Oil base
Centerless	ZA60-K9-V1 A150-05-V10 A60-N5-VBE A80-N5-V30	Thin-walled material Solid or heavy-walled material Solid or heavy-walled material Solid or heavy-walled material	1 gal soluble oil + 50 gal water + ½ lb alkaline metal cleaner
INTERNAL			
Straight or tapered	GA605-J5-V1 FA54-M7-V ZA46-J-15-V2 19A80-J-V	Small holes Medium-sized holes Large holes Small counterbores	1 gal soluble oil + 50 gal water + ½ lb alkaline metal cleaner
SURFACE			
Straight wheel reciprocating type	19A46-K-V 38A46-I-V 18A60-L8-V6		Dry 1 part soluble oil to 60 water Carbon dioxide
Double opposed disk type	87A46-G12-BV 87A46-J11-BW	Through-feed work Ferris wheel work	1 lb sal soda to 10 gal water
Cylinder or segmental type	29A46-F10 KA46-F-16-V2403 57A461-H8-VBE KA46-H16-V1759	Thin work Thin work, bevels and close tolerance work	1 lb sal soda to 10 gal water
Profile work, single wheel section method	A100-L7-V 19A46-K-V 18A60-L8-V6		Dry 1 part soluble oil to 60 water Carbon dioxide
Profile work, crush-roll method	A220-K-V		Oil base
THREAD			
External threads	A120-W2-B7 A100-W2-B7		Oil base
HONING			
Internal	IC-220-M12-VL2F LC180-K12-UL2F		2 parts sulphur-base mineral oil to 3 parts kerosene
ROUGH			
Cutoff	LA302-SB-23366 A36-S7-B1		Dry
Snagging	A162-M10-2893 A364-L10-VB		Dry

Information presented was prepared from material furnished by Haynes Stellite Co., Div. of Union Carbide Corp., Kokomo, Ind.

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Wayne Ewing

President, 1959-60

American Society of Tool Engineers

New Officers and Directors elected at Milwaukee

PRESIDENT Wayne Ewing and six other national officers for 1959-60 officially took their places at the head of the American Society of Tool Engineers at the Annual Installation Banquet held April 21 in Milwaukee's Schroeder Hotel.

Elected by the Society's directors at a meeting just preceding the banquet and installed along with Ewing by retiring President George A. Goodwin were:

H. DALE LONG, vice president. Long is president of Scully-Jones & Co., Chicago.

WILLIAM MORELAND, vice president. He is vice president-manufacturing, F. E. Myers & Bro. Co., Ashland, Ohio.

DAVID A. SCHROM, vice president. Last March, Schrom was promoted to works manager, Grantley Works, York Div., Borg-Warner Corp., York, Pa.

PHILIP R. MARSILIUS, vice president. He is executive vice president of the Producto Machine Co., Bridgeport, Conn.

CHARLES M. SMILLIE, treasurer. He is president of the C. M. Smillie Co. of Ferndale, Mich.

H. VERNE LOEPPERT, secretary. Loeppert, the only new member of the officer group, is vice president of the Boyd-Wagner Co., Chicago. He served last year as chairman of the National Finance Committee and the year before as a member of the committee. From 1951 to 1957 he was on the Membership Committee and held the chair of that group for two years beginning in 1955. A past chairman of Chicago Chapter No. 5, Loeppert has also been active in the Illinois Engineering Council, the Tool and Die Institute of Chicago, and the U. S. Naval Air Reserve, in which he holds a commission as commander.

The New President

Wayne Ewing is ASTE's 28th national president and, at 42, one of its youngest. As president of the Arrowsmith Tool and Die Corp. in Los Angeles and as national office holder in ASTE since 1953, Ewing has exemplified the dynamism so characteristic of the booming West.

He started his career in his home town of Meadville, Pa., as an apprentice tool and die maker at the Talon Zipper Co. While serving his apprenticeship he completed a four-year mechanical engineering course sponsored by Pennsylvania State University. During the immediate prewar years he moved to Detroit and worked as superintendent and engineer in various production lines. In 1942 he founded the Arrowsmith Tool and Die Co. in Royal Oak, a Detroit suburb; next year he moved again, to California to start a branch plant. In 1944 he bought the Los Angeles facility in partnership with Harold G. Murdock. Incorporation followed—and, under Ewing's forceful guidance, the modest tool and die stamping plant evolved over the years into a million-dollar operation.

Also a national director, Ewing assumes the presidency of the 40,000-member Society after serving as assistant secretary-treasurer, secretary, fourth, third, second and first vice president. He has also been vice chairman of the National Membership Committee and is a past chairman of Los Angeles chapter. He is active in the Society of Automotive Engineers, and has worked on county and state committees for the education of apprentices in tool engineering.

Delegates Pick Directors

A day before the banquet and four floors down in the host hotel, the House of Delegates, whose votes voice the opinions of the 157 chapters of ASTE, met in closed session and chose fourteen men to sit for one year on the Society's Board of Directors. The directors-elect will take office at the Semiannual Meeting in St. Louis next October.

The fifteenth member of the board, as designated by the Society's Constitution, will be Goodwin, the immediate past president.

The line-up of 1959-60 directors includes these national officers: Wayne Ewing, H. Dale Long, William Moreland, David A. Schrom and Philip R.

ASTE national officers for 1959-60 posed soon after their election at the 27th Annual Meeting. Left to right, seated, are Charles M. Smillie, treasurer; Philip R. Marsilius, vice president; H. Dale Long, vice president; Wayne Ewing, who succeeded George Goodwin as president; standing, H. Verne Loeppert, secretary; David A. Schrom and William Moreland, vice presidents. They were installed at Annual Banquet.

Marsilius. All are incumbent directors except Moreland. In addition, the following directors were re-elected:

G. BEN BERLIEN, partner, Industrial Steel Treating Co., Oakland, Calif.

IRVING H. BUCK, president, Tool Supply & Engineering Co., Dallas, Tex.

BRUCE FAIRGRIEVE, vice president, Fairgrieve & Son, Ltd., Toronto, Ont.

FRANK F. FORD, president, Frank F. Ford & Associates, Atlanta, Ga.

WILFRED J. PENDER, Potter & Johnston Co., Pawtucket, R. I.

JOSEPH L. PETZ, secretary-treasurer, Petz-Emery, Inc., Pleasant Valley, N. Y.

LESLIE C. SEAGER, chief production engineer, Eimco Corp., Salt Lake City, Utah.

FRANCIS J. SEHN, president, Press Automation Systems, Warren, Mich.

New on the board besides Moreland is DEAN F. SAURENMAN, who is associate development project engineer for the Schlumberger Well Surveying Co., Houston, Tex. A past chairman of Houston chapter, which he joined in 1940, Saurenman has also served a year on the National Editorial Committee and three years on the Standards Committee. He is a graduate of California Institute of Technology.

H. Verne Loeppert
New Officer

Dean Saurenman
New Director

National Committee Chairmen Named

APPOINTMENTS of chairmen to head 14 national committees during 1959-60 were announced at Milwaukee by President Wayne Ewing.

Heading a newly constituted Long-Range Planning Committee will be the retiring national president, George Goodwin. The new group will take over the work of last year's National Progress Committee, which the incumbent Board of Directors voted to discharge.

The Long-Range Planning Committee will be comprised of the directors (both incumbent and elect) and those national officers who are not board members, plus other consultants, advisers or special study members that the committee may designate.

Other new and reappointed national committee chairmen:

Constitution and Bylaws—ARTHUR CERVENKA, chief equipment and process engineer, Grumman Aircraft Engineering, Long Island, N. Y.

Editorial—HAROLD D. SULLIVAN, supervisor, Minneapolis-Honeywell Regulator Co., Minneapolis.

Education—ARTHUR F. GOULD, head of the Industrial Engineering Department, Lehigh University, Bethlehem, Pa.

Finance—DUANE H. BRIGHTON, supervisor, Caterpillar Tractor Co., Peoria, Ill.

Honor Awards—OTTO W. WINTER, president and manager, Winter Engr. Corp., Grand Island, N. Y.

Judicial—T. BERT CARPENTER, president, Bert Carpenter Co., Birmingham, Mich.

Membership—ARNOLD E. UNRUH, tool engineer, General Dynamics-Convair Div., Fort Worth, Tex.

Professional Development—CHARLES H. THUMAN, project engineer, Whirlpool Seeger Corp., Evansville, Ind.

Program—EDWARD H. WHEELER, manager, Standard Pressed Steel Co., Jenkintown, Pa.

Public Relations—BEN HAZEWINKEL, president, Daily Grinding, Inc., South Gate, Calif.

Standards—ARTHUR E. CROM, tool engineer, Consolidated Vultee Aircraft, San Diego, Calif.

Technical Publications—WILLIS J. POTTHOFF, tooling supervisor, Emerson Electric Mfg. Co., St. Louis, Mo.

The chairman of the ASTE Research Fund Committee will be elected by the board at the semiannual meeting this fall. Current chairman is James R. Weaver, a past president of the Society and manager of manufacturing and engineering, Westinghouse Electric Co., Springfield, Mass. Members of this committee are permanent appointees; one is added annually until the membership, now a dozen, shall have reached 15.

By vote of the directors, still another committee—the five-member Off-Shore Chapters Study Committee chairmanned by Phil Marsilius—was discharged, its work complete. The board approved this special committee's recommendations that off-shore chapter activities in the ASTE be increased, except in satellite countries. However, interest in off-shore chapters is not to be promoted from within the Society, but rather is to come from without.

Board Approves Budget for 1960

THE BOARD of Directors in session at Milwaukee approved the ASTE's operating budget for fiscal 1960.

The directors also reviewed the annual reports of the national committees and acted upon recommendations on those reports made by the national officers. Among the recommendations that received the directors' official nod were:

Tentative approval of a 30 percent discount on sales of the *Tool Engineers Handbook*, Second Edition, to members subject to final approval when the actual cost of the book is known. The revised edition is scheduled for publication this fall.

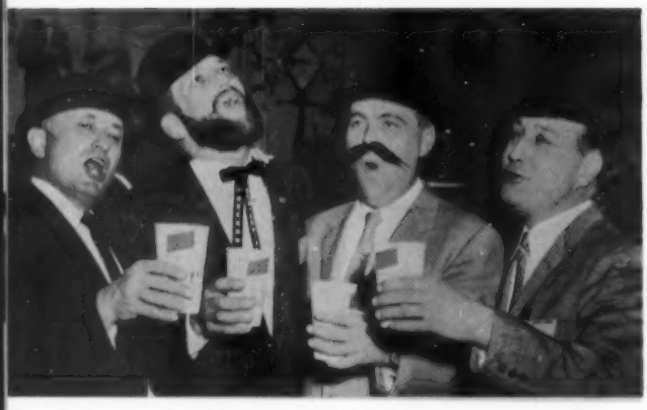
Authorization for the National Standards Committee to support the International Standards Organization at the ISO's coming meeting.

The board approved a resolution of appreciation to the Milwaukee area chapters for their "noteworthy enthusiasm and untiring energy" in staging the 1959 Annual Meeting.

In addition, the directors approved by resolution the proposed application by ASTE for affiliate membership in the American Association for the Advancement of Science.

Biggest little hit of the Milwaukee convention was a doll (center) named Ithaca, who perched atop the delegate's placard bearing the number of the ASTE's baby chapter. Little Ithaca's constant companions were (left) Chapter Chairman Arthur W. Green and (right) First Vice Chairman Donald E. Gibson.

Some Who Were There . . . .



Regardless of the two rebels in the middle this impromptu barbershop quartet entered right into the spirit of the old Milwaukee Willkommen. Emitting what at least look like pearshaped tones are (left to right) National Director Irving H. Buck, Portland Chapter Chairman Glen Kach, Louisville Chapter First Vice Chairman William Exely, and Louisville Chapter Chairman Earl Klein. The foursome was accompanied by a German band which also provided music for those eager to exercise their feet rather than their vocal chords.

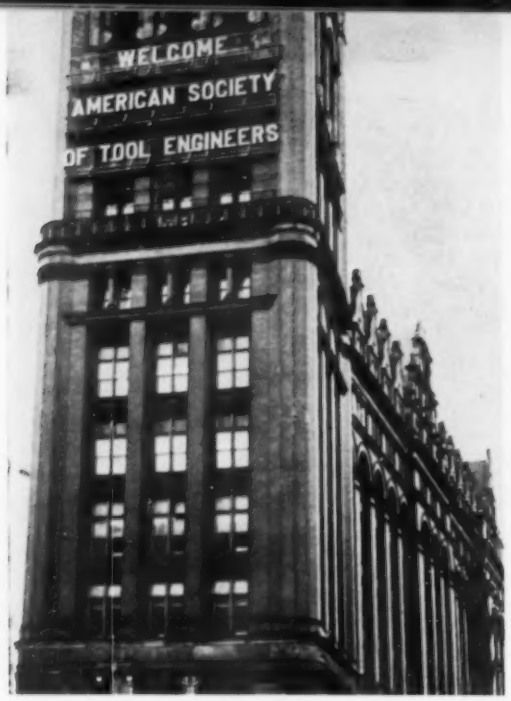
Obviously pleased but just a bit surprised at the amount of German-style food they succeeded in heaping on their plates at the Willkommen are (left to right) Harry Todd of the Salt Lake City chapter, National Director and Vice President Dave Sehrom, Long Island Chapter Chairman Sheldon Meyers, and Dominik Scolaro of the Greater New York chapter.

Joint ASTE-ASME session, first in the technical paper exchange program worked out by the two societies, drew a gratifying audience in Milwaukee. ASME participants were (left to right) G. A. Peters, consultant El Segundo Div. of Douglas Aircraft Co.; D. G. Taylor, staff engineer, Minneapolis-Honeywell; J. R. Brand, assistant director of du Pont's Mechanical Development Lab.; and J. F. Downie Smith, vice president-research and development, Carrier Corp. Peters, Taylor and Smith presented papers. Brand, who is on the meetings committee of ASME's Machine Design Division, chairmanned the session.

The Milwaukee convention attracted a greater number of ASTE wives than any meeting in recent years. Here at the auf Wiedersehen breakfast on the last day, are part of the 128 who registered for the various ladies' activities.

. . . . and One Who Wasn't

Present in spirit but physically flat on his back in a California hospital was John Stansbury, host committee chairman of the ASTE's convention and Tool Show in Los Angeles last fall, and charter chairman of Long Beach chapter. Friend Ray Gariss (standing), vice chairman of the National Technical Publications Committee, brought along this picture to Milwaukee. Despite an operation to correct osteomyelitis, Stansbury has continued working on the new technical book for the NTPC on tooling for aircraft and assembly.



Milwaukee

FROM THE BIG BLOCK letters across the tower of City Hall to such small but not insignificant things as a handshake and a smile, the 812 registrants at ASTE's 27th Annual Meeting April 18-22 found more meaningful signs of welcome in Milwaukee.

Attendance figures, however, fail to tell the story. While 483 attended the Honor Awards Dinner, 518 turned out for the Milwaukee Day Luncheon, over 400 attended the eleven plant tours scattered over the three weekdays of the convention, 447 stayed around for the climactic Annual Installation Banquet—all these statistics pale when posed against the larger significance of the convention, the spirit of downright unabashed enthusiasm.

Undoubtedly the event that best manifested this spirit—now ASTE members know what Gemütlich keit is, never mind how it's spelled!—was the old Milwaukee Willkommen party held on Sunday evening, April 19, at the host Schroeder Hotel. How many attended the Willkommen? Everybody.

One of the largest turnouts of wives in recent years, 128, was shepherded through three days of hospitality, coffee, shopping, tours of Milwaukee's cultural and scenic attractions, and a concluding "auf Wiedersehen" breakfast. A seven-member Ladies Activities Committee was chairmanned by Mrs. Beverly Wacker, wife of Host Committee Chairman Larry Wacker.

At the luncheon honoring Milwaukee area industry, Wacker, who served as toastmaster for the affair held on Monday, introduced Wm. J. Grede, who gave the speech (reported below). Outgoing President George A. Goodwin delivered words of welcome from ASTE, and Mayor Frank Ziedler of Milwaukee spoke for his city. The mayor pointed out that Milwaukee, while being 13th in population in the country, ranks eighth in industry, and can be justly proud of the highly concentrated technical skills and brains among the 46 population groups which make up the "machine shop" of America.

ASTE's 1959 Honor Award winners look at the Gold Medal won by Dr. Alfred O. Schmidt (seated, left), chief research engineer, Kearney & Trecker Corp. Sitting with Schmidt is T. Bert Carpenter, president, Bert Carpenter Co., and a past president of ASTE, recipient of the Joseph A. Siegel Memorial Award. Other winners (standing, left to right) are Dr. Mark Ellingson, president of Rochester Institute of Technology, Education Award; Prof. Kenneth J. Trigger, department of mechanical engineering, University of Illinois, Research Medal; Swan E. Bergstrom, president of The Cincinnati Milling Co., Eli Whitney Memorial Lecture Award; George Romney, American Motors Corp. president, Progress Award; and Jacob J. Jaeger, vice president and chief engineer, Pratt & Whitney Co., Engineering Citation.

Romney Urges Revival of Economic Incentives

Highlighting the first major session of the convention, George Romney made a strong plea at the Honor Awards Dinner for tool engineers to help counter the trend away from an economy of freedom in the United States.

Addressing his audience as "the greatest collection of mechanical eggheads in the world" and thanking the ASTE for honoring him with its Progress Award "for what others have done," the American Motors Corp. president declared:

"Our great adversary (Russia) has moved toward

Convention Highlights

a society of incentives while we've gone the other way. America should not be reducing benefits and awards for economic effort and achievement. It should be increasing them."

Romney said this country has established a superior system, where political freedom reigns and customers hold the economic balance of power. "We have an economic society of the people, by the people and for the people. We have a society of consumerism, not capitalism, where not a few benefit from the efforts of the many, but the many benefit from the efforts of the few.

"But nothing is more vulnerable than entrenched success. That is America's razor edge of danger."

The strong-featured Ishmael of the automotive industry attributed American success of the past—in which the ASTE has played such an important role—to these fundamentals of economic freedom:

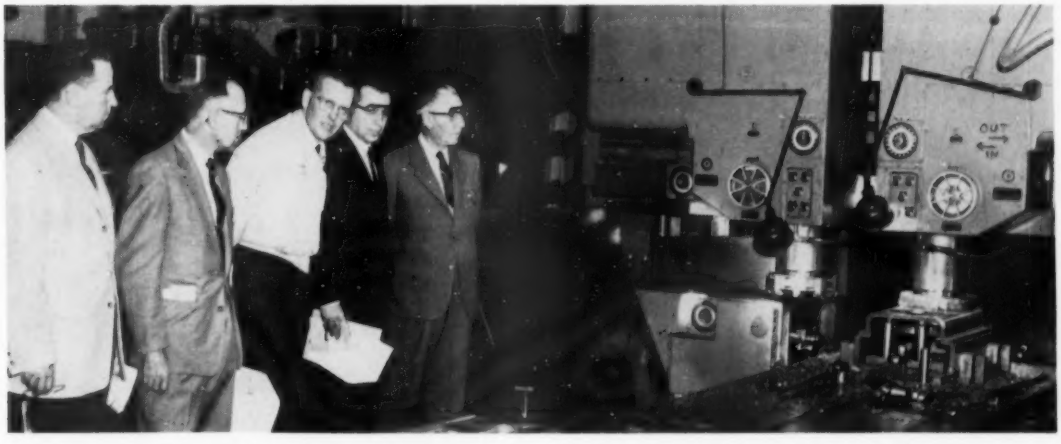
- Competition
- Voluntary cooperation and organizational contribution
- Rewards for achievement
- Distribution of benefits among consumers, owners, management and workers.

It is in the basic concept of voluntary cooperation that the ASTE has the greatest opportunity for service to a free economy, Romney asserted. For the ASTE's purpose is not only development of new technological ideas, but the sharing of them.

Col. John P. Taylor, assistant chief of the Aircraft Laboratory at the Wright Air Development Center in Dayton, took his audience "Adventuring in Space" at the Annual Banquet. Supplementing his talk with spectacular films and a life-size model of a space chair, Taylor said the lives of our space pioneers will depend upon tool engineers attaining a degree of precision and reliability unheard of to date.

"Superior tools and superior ideas have made this country what it is. We'll need both in the struggle for survival that's ahead of us. We're living in a world of competition in ideas, and we can't go back to artificial barriers and supports."

Swan E. Bergstrom, president of The Cincinnati Milling Machine Co., gave the third annual Eli Whitney Memorial Lecture as the man who most



Plant Tour No. 7, one of the 11 tours scheduled for convention visitors, found Falk Corp. plant guide Arland Cap (center) showing off the Giddings & Lewis milling machine as it milled 315J shaft mounted drive housings. In the group are Karl Friedland, Robert Ellison, Marc Lechtenberg, and John Cazemero.

Leadership Conference brought together these chapter chairmen who learned they all work for the same company—Raytheon Corp. missiles division. Seated are Nicholas W. Juliani, Boston Chapter No. 33, and Robert Ellison, Granite State No. 86; standing are R. W. Burton, Bristol, Tenn.-Va. Chapter No. 155; and Salvatore Gianino, North Shore No. 146.

nearly approximates the life and accomplishments of the father of mass production. In his paper titled "The History of Metal Cutting," Bergstrom showed how more progress has been made in developing metal-cutting tools in the last 150 years than since the beginning of recorded civilization.

Milwaukee Day Speaker Calls for Tax Reforms

Taking his cue from the "Planning for Profit" theme of the 1959 Convention, William J. Grede (pronounced "Grady"), Milwaukee-born president of Grede Foundries, Inc., called for "drastic tax reform if we're going to preserve our freedom to make a profit in a competitive economy" in his address before the Milwaukee Day Luncheon audience.

Grede, an outstanding industrialist and civic leader whose firm comprises seven foundries in three midwestern states, cast compliments on the ASTE for being practical and courageous enough to set its theme "when in so many circles 'profit' is a dirty word. Your action belies the statement that a profit is without honor in the home community—and it's an honor for me to be invited to address you. . . ."

In his talk entitled "Profits, Taxes and Freedom," Grede assailed the federal tax structure and the progressive income tax in particular as being "most destructive of much of our American dynamic venture—incentive—and just plain drive.

"Although I'm not advocating trade with Russia, this progressive income tax is one thing we could well afford to export to them. Strange as it may seem, the top Russian income tax rate is only 13 percent. In the United States the top rate on individuals is 91 percent. Of course, the Russian leaders have ways of squeezing more than income taxes out of people. But the contrast in the top rates shows to what fantastic lengths the destruction of savings and capital, by means of the progressive rates, has proceeded in *this* country."

Taxes are necessary, Grede said, but they need not be a necessary evil. Tax reform is needed based on nondiscrimination and individual freedom.

To counter the Soviet challenge in both economic leadership and military potential, to finance new job opportunities, to provide more risk capital and assure adequate revenues for defense, to "smother inflation with growth," Grede advocated passage of legislation now before the U.S. Congress.

That legislation, popularly known as the Herlong-Baker bill, attempts to correct the fundamental tax

Typical Leadership Conference scene was this workshop table at the faculty advisers' conference. Reading around the table from left are Frank W. Williams, Sinclair College, Dayton, Ohio; William J. Lewis, Jr., Hudson Valley Tech, Troy, N. Y.; Robert J. O'Brien, Ohio College of Applied Science, Cincinnati; John D. Sprinkel, Long Beach City College; Gilbert E. Seeley, ASTE education director; James G. Meade, Connecticut State Tech; Arnold J. Blythe, Lawrence Tech, Berkley, Mich.; and John A. Gaciorowski, Milwaukee.

problems not by nibbles and bites, Grede said, but by overhauling the basic tax structure. Its major provisions: five annual reductions in individual income tax rates, which would bring the first bracket down from 20 percent to 15, the top rate from 91 to 47, and all the rates in between proportionately: five annual reductions of one percentage point each in the corporate tax rates. The revenue effect of these proposed reductions would be about $2 billion annually in individual taxes and $400 million annually in the corporate rates. However, the apparent loss of revenue to the Government would be more than offset by the increased revenues from economic growth, Grede contended.

"Economic growth resulting from the removal of tax blocks will create the revenues to more than make up for the savings to taxpayers," he said. "If, as expected, economic growth should average 5 percent annually over the next five years with this legislation, there would be an annual surplus of revenue increase of at least $1½ billion.

"We cannot continue to base federal tax and budget policy on short-term considerations . . . fighting inflation one year and recession the next. Our economic progress depends on tax reform. Our freedom depends on ridding ourselves of this octopus of regulation."

Leadership Conferees Get 'Take-Home Pay'

Some take-home pay that won't be deposited in a pair of wifely hands was collected by more than 200 "workers" at the annual Leadership Conference —the new chapter chairmen (delegates) and first vice chairmen (alternates), plus, for the first year, the faculty advisers from the student chapters, who were given the chance to discuss and develop solutions to their individual problems at one of the four Faculty Advisers discussion groups.

The pay—ways and means of becoming more effective Society leaders—came in the guise of pep talks, conference-table discussions, films, comradeship, and a series of question-and-answer skirmishes that left Palefaces pale and Indians scalped. And Society leaders are banking on the expectation that participants will deposit the payload where it'll draw the most interest—in the chapters back home.

Format booklets appropriately labeled "Take-Home Pay" and containing space for copious note-taking were distributed to the conferees at the beginning of the week-end clinic. Delegates were arbitrarily divided into two camps, Palefaces and Indians, to add a competitive spirit to the sessions.

At the kickoff breakfast Saturday morning, President George Goodwin called on the conferees to take full advantage of "two days in which to recharge your batteries." He said they would be absorbing much material that would be familiar, but also much material that is *new*. "This is as it should be," he added, "for new ideas, new approaches, are a sign that ASTE isn't static."

Star of the general sessions was Vice President David A. Schrom, who spun a wheel of fortune and yielded a microphone in the contests between Palefaces and Indians as impartially as any Indian could. With the wheel he selected questions to direct at the vying delegates, and with the mike he manipulated the answers as expertly and entertainingly as a professional emcee.

A sample question: "What is the amount of scholarship aid granted by all ASTE chapters for 1959?"

Answer from delegate Earl Williams, San Diego: "All they can afford!"

Answer from Hugo Aglietti, one of the judges and immediate past chairman of the National Professional Development Committee: "An estimated $14,000."

Both answers were correct.

The consensus of a cross-section of participants who were interviewed seemed to be that the Leadership Conference, as a concentrated indoctrination course in Society and chapter administration and procedures, was painless and profitable.

The consensus among conference narrators, moderators, stage hands, and resource men was that the Palefaces and the Indians—the ASTE's grassroots leaders—are very much on their toes. There was one possible exception, an observer noted: that was the delegate who, when asked his name, had to look down at his badge before answering.

Investment Pays Off

Karl Anderson, a young man from Detroit, personifies what might be called the ASTE success story. This story was made known at no more appropriate place than the two-day Leadership Conference in Milwaukee. Prof. Arthur Gould, chairman of the National Education Committee, pointed out Anderson as epitomizing the worth of the Society's student chapters—and especially the worth of its scholarships.

The story began when Karl was chosen chairman of the ASTE student chapter when it was chartered at Wayne State University in 1955. That same year he was the recipient of an ASTE International Education Award of $700.

Today Anderson is an instructor in the engineering department at Wayne State.

But that's not all the story. Anderson was not one to abandon the Society when he gained his instructorship. The same group which he had chairmanned four years earlier in his student days now claims him as its faculty advisor.

Members in the News

G. LUTHER PARSONS, Richmond chapter, has been appointed plant manager of the main plant of Perfect Circle Corp. at Hagerstown, Ind. Previously Parsons was superintendent of tool room and maintenance for the piston ring firm.

One of the founders of Houston chapter who now is a member in Cleveland, LESTER M. ("RED") COLE, has been elected vice president in charge of sales for Warner & Swasey Co. Cole started with the company as a tool designer and most recently was general sales manager. In his new position he will direct all sales activities in the Machine Tool Div., as well as those of the firm's textile machinery and earthmoving equipment divisions. He has been active in both NMTBA and ASTE, having served on the Society's National Education Committee.

Indicative of the diversified interests of ASTE's cosmopolitan membership, a tool engineer with the courage of his convictions has published an earnest and unusual book called *The Correct Way of Life*. The Egyptian-born author, ABDO S. AHMED, is a member of Santa Clara chapter and works in the product design department of Beckman Instruments' Spinco Div., Palo Alto, Calif. His highly personal essay attempts to combine the ancient tenets of Islam with the ideals of American democracy and, in its industrial aspects, explores the thesis that America can best fight communism in underdeveloped nations by strengthening the economies of those nations. Ahmed donated a copy of his book to the ASTE Headquarters library.

Elected to the board of Latrobe Steel Co. was R. T. EAKIN, Detroit chapter. Eakin is vice president of operations and joined the company last year from Allegheny Ludlum Steel Co., where he was works manager of the Brackenridge, Pa., plant. . . . GORDON GRAHAM, Long Beach chapter, has been named plant manager, a newly created position, with the Southern Pipe Div. of U. S. Industries, Inc., Azusa, Calif. Graham, who has been with the firm for the last six years, will continue as chief engineer. . . . The L. S. Starrett Co., Athol, Mass., has appointed four members of Northern Massauchusetts chapter to its sales staff: D. F. RICHARDS will serve in the Cleveland territory; W. E. GILLIS will be located in Los Angeles; W. E. STAVELEY moves to Atlanta, Ga.; and P. T. WICKHAM will serve western New England.

Abdo Ahmed

L. D. Fykse

L. M. Cole

GEORGE A. ROBERTS, vice president-technology of the Vanadium-Alloys Steel Co., was re-elected president of the Metal Powder Industries Federation. . . . RICHARD T. THORNTON, Detroit, has been named general manufacturing manager of the Ford Motor Co.'s Hardware and Accessories Div. He will direct operations at the division's plants in Sandusky, Ohio; Ypsilanti, Rawsonville, Highland Park, Mt. Clemens and Brooklyn, Mich. . . . Appointment of LEWIS D. FYKSE, Greater New York chapter, as director of marketing has been announced by Associated Spring Corp., Bristol, Conn. Fykse has been marketing services manager for American Machine & Foundry Co. for the past two years. In his new position he will be responsible for guiding all sales, market research and advertising activities of the corporation and its 12 operating divisions. . . .

JOSEPH A. MALLISON of St. Marys, Pa., has become a registered professional engineer in his state. He has been program chairman of Northwestern Pennsylvania chapter for the past two years.

Brown & Sharpe Mfg. Co. of Providence, R. I., has named ARNOLD N. HELLEWELL as sales director for the Turret Drilling Machine line, recently acquired through the company's purchase of Howe & Fant, Inc., of East Norwalk. Hellewell, a former Brown & Sharpe apprentice, has been located in the firm's Ohio territory. . . . MILTON T. SCHIMMEL, Centinela Valley chapter, will direct expanded West Coast operations of the Logo Div. of Bee Chemical Co., at Gardena, Calif. . . . WARREN G. BRUNS has been named district manager, St. Louis office of Pratt & Whitney Co., Inc. He's a St. Louis chapter member. . . . B. H. WILDENHAUS, for 19 years district manager for the grinding tool division of Simonds-Worden-White Co., in Dayton, Ohio, has been appointed manager of distributor sales.

Texans Tackle Communications

By Vergil B. Clark*

Management & Supervisory Training Specialist
Engineering Extension Service
Texas A & M College System

COMMUNICATIONS is a big problem in industry, as everyone knows.

It's a big problem in Texas industry too, as everyone might assume. But, for once, the Texas variety isn't bigger than elsewhere; in fact, Texas communications problems may be smaller, thanks to the joint educational attack by an ASTE chapter and the Engineering Extension Service of Texas A & M College.

A year ago this month, East Texas Chapter #126—which meets at the airport serving Longview, Tyler and Kilgore—heard a speaker explain a supervisory and management development training series offered from Texas A & M. As the speaker progressed from one training course to another, the members of the chapter began to envision the value of this type of training to industries and supervisors in the East Texas area. When he had finished, the progressive-minded chapter voted unanimously to sponsor the training program for its members and anyone else who might benefit.

One of the first and most successful courses that evolved from that meeting night was a course in industrial communications. And to show that communications is no one-way street, the instructor himself joined the ASTE after the third class he conducted.

As supervisory and management trainer for the college's Engineering Extension Service, I was both the speaker and the instructor mentioned above.

Chapter leaders and committee chairmen worked hard, and deserve full credit for the results that soon began to appear. The leg work involved in selling and organizing classes of from 15 to 20 members, drawn from management and supervi-

*Senior member East Texas ASTE chapter.

sion of area industries, began to pay off within a month of the chapter's decision to sponsor the training program. From June 2 to June 6, 1958, the first in a series of six courses was conducted at the LeTourneau Technical Institute in Longview, with a full class enrollment of 20.

Results of the first course were evaluated by the class members for effectiveness and on-the-job application value. More courses were requested, and the college assigned me to work with the chapter in developing programs for the entire East Texas area.

2235 Student Hours—So Far

Since then, the ASTE chapter has sponsored a total of 2235 student hours of supervisory and management training—and both the chapter and the college feel that we have only scratched the surface.

The six courses, presented at various institutions and plants in East Texas, include fundamentals of supervision; personnel relations; methods improvement; effective employee training; safety; and industrial communications. In addition, courses in motivation and labor-management contract communications have just recently been added, and plans are underway by the chapter and the trainer to offer classes in costs, work simplification, and quality control.

The unit courses are conducted three hours a day or night at $15 per enrollee. The length is one week or five sessions, usually Monday through Friday. Many of the people who enroll in the classes are ASTE senior members, but many are nonmembers—but potential members! Some of them drive distances of 75 to 100 miles, after work, to attend the classes. Some companies pay the enrollment fees, but many of the students dig down in their own pockets to help themselves do a better job for the company that employs them.

"Communimeter" Challenges Class

None of the courses has been better received than the one in industrial communications, largely because it has as its nucleus a challenging and baffling electronic instrument called the "Communimeter."

Basically, the instrument consists of a panel containing a series of electrically connected dials which can be manipulated successfully only as a result of the most accurate and painstaking communications between an instructor (student) and operator (student). The student instructor, representing a supervisor on the job, gives instructions to the operator, representing an employee.

Invariably an inexperienced team will assault the innocent-appearing instrument with a confidence approaching smugness. Invariably, however, they soon run into "communineering" problems. They will use a confusing and conflicting variety of terminology and rotation descriptions in their attempts to manipulate a dial into a position that satisfies both supervisor and operator. Such words as "clock hour hands," "degrees," "minutes," "counterclockwise," "turn to right" (whose right?) "the dial," "the knob," "the gadget," "the doohicky," may be heard during the manipulation of one dial.

The instrument dramatically demonstrates the need for developing precision and clarity in our industrial communications. If a team does not bring precision and clarity to the Communimeter, clanging bells and flashing red lights inform them that they have missed the boat in communications.

In our day-to-day communications, we have no flashing lights and ding-dong bells to tell us our message is not being received. Often the only clues we have to warn us that we have failed to "get across" effectively are:

- Misunderstandings
- Disagreements
- Costly errors
- Inefficient operations
- Poor interpersonal relationships.

When used with a tape recorder, the Communimeter points up that one-way verbal instructions alone prove hopelessly inadequate; and that many people can hear themselves giving instructions to themselves, try to follow their own instructions, and fail. Other analysis factors that the device indicates are:

- It's very difficult for one person to describe a "picture" or concept so that another person can get the same picture or concept
- We have no way of finding out exactly what kind of picture or idea we may be creating in the other person's mind
- We avoid detail, do not assimilate detail, and tend to assume too much
- Words do not mean the same to everyone; a word has meaning to a person only in terms of his past association with it
- What may seem quite clear to one may be ambiguous to another
- We often try to impart information when we ourselves have only a hazy concept of what we are trying to explain.

No operator-instructor team has yet been completely thorough enough in communications to make the Communimeter perform on the basis of verbal instructions alone. Only through a triple approach—verbal and written instructions, plus close personal supervision—has the operation been performed satisfactorily.

People are seldom really able to communicate accurately, either on a Communimeter or in real life. But they can try, as they're doing in Texas—and that's half the battle.

York Chapter Chairman Dick Streitmiller extends a welcome hand to bus load of students and staff members from Scotland School for Veterans' Children. Plant tours, lunch and dinner filled out the boys' day.

Chapter Fetes Adopted Sons

ONE OF THE MOST effective dramatizations of goodwill in the annals of ASTE chapters is enacted each spring in the aging, appealing city of York, Pa. On April 1, tool engineer members in the highly industrialized but beautiful area south of the Susquehanna played their humanitarian roles for the seventh year running when they hosted the student sons of deceased or destitute war veterans.

Twenty-eight boys, juniors and seniors from the machine, sheet-metal and electrical classes of the famed Scotland School for Veterans' Children near Chambersburg, Pa., spent half a day and a fourth of the night with members of the 22-year-old ASTE Chapter No. 22. The boys toured plants, saw the sights and three movies, ate plenty, and listened to short and painless speeches.

As have their predecessors in the annual affair, they enjoyed it. Charles A. Goldstrohm, vocational director from the state-supported school which has a faculty numbering one for every four students, expressed his charges' gratitude for a profitable and enjoyable day. "In this seventh year of the project," he told the jointly assembled students and chapter members that evening, "I can only say thanks seven times to you tool engineers—thanks times seven!"

Hans Erich, German immigrant who has risen to manager of manufacturing at the York works of Caterpillar Tractor Co., dished out some advice to the boys on how to make the most out of life—and how to give the most. He urged them to serve not only their employer but also their community.

"It takes more than a box of matches to burn down the world," he declared. "But above all—win or lose—don't feel sorry for yourself. I complained about my shoes until one day I met someone without feet."

Among those present at the meeting which climaxed the boys' big day were David A. Schrom, chapter member and national vice president, and Program Chairman W. D. (Bud) Craver, Jr., one of those responsible for starting the chapter's unusual experiment in human relations. —*M. L. Stone*

An observant trio sees finishing touches put on cabinets during boys' tour of Colonial Products Co. Chapter arranges different student tours each year.

Nothing thaws out a youngster like a good serving of ice cream. Here the boys dip in during ASTE-arranged tour of dairy at Red Lion, Pa.

chapter news and views

Seen demonstrating a magnetic particle inspection device during one of the lectures at Wentworth is Ferdi Stern, Magnaflux Corp. Shown are (seated left to right) Stern, Chapter Chairman Joseph Woisard, and Faculty Advisor Roger Borden. Standing are members Carlos Somoza, Louis Thompson, Walter Worth, and Andy D'Apice.

HARTFORD—Named as the officers to head Chapter #7 are (seated) Paul F. Pick, chairman; Howard A. Wheeler, first vice chairman. (Standing) Lee A. Girardi, secretary; Joseph B. Paige, second vice chairman; and James B. Wilkie, treasurer.

—E. Russell Carter, Jr.

Nondestructive Testing Lectures Held at Wentworth

WENTWORTH INSTITUTE—A series of lectures designed to supplement regular courses and to give a basic knowledge of the theories, methods and applications of various well-known nondestructive tests were held as part of the regular meetings of the Wentworth Institute student chapter. The course, conducted by the Society for Nondestructive Testing, was the first of its kind at Wentworth that was devoted to a specific area of engineering. Twelve lectures were delivered by specialists active in the Boston chapter of the SNDT.

The series began Feb. 3 with a talk by Ferdi Stern, Magnaflux Corp., on "Sources of Defects." Stern disclosed how nondestructive tests enable a manufacturer to produce flawless parts economically. If defects do exist they are usually in cast, rolled, forged, machined, or heat-treated parts.

The second lecture by Robert Halliday, Arnold Greene Co., supplemented Stern's talk with films, thus enabling the students to see tangible examples of the magnetic particle inspection operation.

Explaining the penetrant inspection methods of nondestructive testing was Seymore Carter, Charles Morgan Co., a specialist in this field. Carter illustrated how defects in nonmagnetic parts can become easily recognizable by the application of penetrant dyes and developing agents to the surface of the part.

The theory of ultrasonic inspection methods was presented by John Bobbin of Branson Instruments. This was followed by two lectures delivered by Peter Block also of Branson and T. W. McFarlan, Sperry Co., on the actual operation methods used in conducting various ultrasonic tests on a variety of machine parts.

The final method of testing, X-ray inspection, was clarified in both theory and practice by J. G. Sylvester, head of J. G. Sylvester Associates, and Arnold Greene, Arnold Greene Co. Where other methods proved too difficult or entirely unfeasible, this X-ray inspection technique proved highly practical.

The last event of this series was a panel discussion consisting of the entire line-up of lectures. Its purpose was to enable the Wentworth students to clear up any questions that might have occurred to them during the talks.

The members of Student Chapter #7 felt the entire series a valuable addition to their classroom education in engineering. *—Peter H. Loftus*

Schrom Urges Wives To Encourage Tool Engineer Husbands

GREATER LANCASTER—Directing his talk to the ladies present at the Ladies Night gathering, ASTE Vice President David A. Schrom encouraged them to inspire their tool engineer husbands in their very important field.

Schrom also spoke of the rising costs of production and how we are "pricing ourselves out" of, not only the world market, but our own too. He pointed out that the volume of imported manufactured goods is rapidly increasing because of our inability to compete with foreign prices.

The best way to combat this problem, Schrom suggested, is with tooling for production. The tool engineer has been too complacent in facing this challenge from abroad. Schrom said the solution to the problem lies in the tool engineer's hands, and the time is ripe to start mixing that solution.

It was announced at this meeting that 23 men completed the course in advanced tool engineering which was sponsored by Chapter #89. A certificate was presented to each man by John Denuel who supervised the course.

An additional highlight of the meeting was the installation of officers. They are Dale W. Sensenig, chairman; Harry E. Medsger, first vice chairman; Fred J. Long, second vice chairman; Ralph F. Wolf, treasurer; Francis N. Hull, secretary; and Robert C. Kaley, assistant secretary. —*James E. Boyer*

The Makings of a Suppliers Directory

Standing triumphantly alongside a small mountain of correspondence, questionnaires and other forms that went into the making of THE TOOL ENGINEER Suppliers Directory Issue that he's holding is directory editor George M. Hargreaves. Not present for the photo, said Hargreaves, were the magazine's other editorial and business staffers, printers, artists, agency men, research personnel, thousands of manufacturers who filled out forms, ASTE members who helped in planning—and some 20 girls who sorted, coded, typed, posted, and pasted. Work on the directory, which is due to be published the middle of this month, consumed some 8,500 man-hours, directly, many more indirectly. Mountain of material in picture represents galley sheets of 19,000 sales office listings; 16,000 cards containing product listings; 2,500 manufacturers' names with 45,000 distributor listings under them. Out of all this will come a 600-page directory packaged to fit the product information needs of tool engineers.

BRISTOL, TENN.-VA.—Charles S. Rockwell, president and general manager of Sperry Farragut Co., Bristol, and of Ford Instrument Co., Long Island City, N. Y., divisions of Sperry Rand Corp., will speak at the June 18 meeting of the chapter. —*Edward F. Moore*

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LOUISVILLE—Posing for their first official picture after their installation are the new officers: (front row) W. M. Exely, first vice chairman; E. W. Klein, chairman. (Second row) R. H. Holzknecht, secretary; F. J. Wlodarek, second vice chairman; and G. A. Mercer, treasurer. *—Sam T. Gleaves*

MACOMB—Past President Leslie Bellamy installs the new officers (left to right) Herbert Hiser, chairman; Theodore Ekman, first vice chairman; Donald Everhart, second vice chairman; Joseph Fox, secretary; and Michael Bentz, treasurer.

DETROIT—Elected for the 1959-60 term of office are (seated, left to right) Joseph F. Wrobel, first vice chairman; Bernard J. Wallis, chairman; and Stanley Commer, second vice chairman. (Standing) Joseph J. Gabrick, third vice chairman; Eugene Makie, secretary; and Edward M. Till, treasurer.

WICHITA—Chapter No. 52's officers include (left to right) Dave Duffy, first vice chairman; Jim Hill, immediate past chairman; Bill Unruh, chairman; and William Chambers, second vice chairman. Not shown are Glen Dolton, third vice chairman; Herbert Bealer, secretary; and Doyt Greer, treasurer.

Boston Chapter Hears Die Set Experts

BOSTON—"Die Set Applications and Problems" was the subject of talks delivered at the Boston chapter's April meeting by Donald H. Gardner, vice president of eastern sales, Standard Die Set Co., Providence, R. I.; and Pat Stavalone, manufacturing manager at the same firm.

Introduced by Program Chairman David Whittemore, Gardner and Stavalone described the problems and applications of die sets with respect to today's modern facilities for production stamping. They showed color slides on the manufacturing of all types of die sets using the latest production and inspection equipment and techniques which turn out the precision products called for by today's exacting requirements.

Following the regular meeting was a film on the construction of the Chesapeake Bay bridge.

The new officers of the Boston chapter installed at the March meeting are Nicholas Juliani, chairman; Joseph D'Avella, first vice chairman; Seymore Benedetto, second vice chairman; Charles Roth, secretary; and Thomas Kenney, treasurer. *—Lester F. Horne*

LONG BEACH—Outgoing Chairman Chuck Ward presents new Chairman Irvin P. Also with a bell instead of a gavel. Other new officers of Chapter No. 84: Lyman W. Allen, first vice chairman; E. J. Van Wagner, second vice chairman; O. D. McDougall, third vice chairman; O. E. Mueller, secretary; R. Blake Broadway, treasurer. *—Paul J. Bodnar*

Elections and Plant Tour Highlight Valley Meeting

MERRIMACK VALLEY—Approximately 125 members and guests of the Merrimack Valley chapter were in attendance at the Spaulding Metal Works on Feb. 5 for a discussion of modern foundry practices. Laurence Spaulding, president and general manager at Spaulding, hosted the affair and talked on the everyday problems encountered in the pattern making and metal casting industry. Following the discussion was an informal plant tour during which many of the plant's operations were demonstrated by Spaulding employees.

Highlighting the evening's activities, however, was the election of officers for the new year. Those elected were: Leighton L. Reynolds of Towle Mfg. Co., Newburyport, Mass., chairman; Leon H. Rice, Jr., of Leighton Machine Co., Manchester, N. H., first vice chairman; Alsdon H. Arold of Bolta Products, division of General Tire & Rubber Co., Lawrence, Mass., second vice chairman; Alfred W. King of Goodwin & King, Nashua, N. H., secretary; and Dante J. Patti of the Merrimack Valley Works of Western Electric Co., North Andover, Mass., treasurer.

—Dante J. Patti

Educational Program Participation Urged

DES MOINES—When Past President George Goodwin spoke at the Des Moines chapter's March meeting, he stressed the need for every chapter's participation in the ASTE educational program. Leaving all the work to a handful of chapters is totally unfair. The ASTE educational program is set up on a national basis but it's up to the local chapter to use its own initiative in designing educational projects suited to its individual needs. Taking part in on-campus conferences, career day sessions and similar affairs, Goodwin said, marks the chapter and its members as conscientious and unselfish.

That which prompted Goodwin's talk on education was the awarding of a $400 scholarship from the Des Moines chapter to Iowa State College. Presented to the school's assistant dean, John Lagerstrom, the scholarship is to be given to some student chosen by the school officials.

Goodwin administered the oath of office to Walter Cocks, chairman; Jesse Howe, first vice chairman; Raymond Hicklin, second vice chairman; Wendell Jones, secretary; and Bernhard Beall, treasurer.

—Don E. Waggoner

TWIN CITIES—National Director Joseph L. Petz (left) poses with officers whom he installed at Minneapolis meeting: Gerald F. Oppel, chairman; George A. Minarik, first vice chairman; Arthur J. Stockwell, second vice chairman; Frank Liljemark, secretary; and R. Roy Wressell, treasurer. ***—D. W. Johnson***

GREATER NEW YORK—Chapter #34's new officers are (seated) Herman S. Freiman, chairman; Dominic R. Scolaro, first vice chairman. (Standing) Joseph A. Papa, secretary; Gerald Abbott, treasurer; and Alfred M. Sampter, second vice chairman. ***—Alfred M. Sampter***

TRENTON-DELAWARE—Officers of Chapter No. 138 are (left to right) Robert Poole, second vice chairman; Robert Petersen, outgoing chairman; Philip Walker, treasurer; Morris W. G. Bahr, chairman; and Edwin Londahl, first vice chairman. Not present was Edward Manley, secretary. ***—J. L. Weber***

Broaching Advances Told at San Francisco

SAN FRANCISCO—The importance of getting a good MRS finish on tools and workpieces was brought out in a speech by Kenneth N. Macomber, chief service engineer, Lapointe Machine Tool Co., Hudson, Mass., in a talk before the San Francisco chapter at their March meeting.

In his talk entitled "Precision Broaching," Macomber related that the high production of broaches as in milling results in higher profits. He used films to show how to estimate metal removal with broaches.

The new officers installed at this same meeting were Frank Sweet, chairman; Michael Flynn, first vice chairman; Gilbert Hutcheson, second vice chairman; George Grover, Jr., secretary; and Jack Corey, treasurer. Ben Berlien, ASTE national director installed them. Wilbur Russell, retiring chairman, spoke briefly on the progress made by the chapter since its beginning and its great potential for the coming years.

—Chester L. Norton

San Gabriel Sponsors New Student Chapter

SAN GABRIEL VALLEY—Chapter No. 95 will sponsor the chartering of Pasadena City College student chapter at their regular meeting to be held at the Dinnerhorn Restaurant, Covina, Calif., on June 4. Tentative plans call for new President Wayne Ewing to act as installation officer.

—Bernard K. Allen

Experts Describe Spark Machining

CALIFORNIA POLYTECH—The spark erosion process was discussed by two experts, Leo Hahn, vice president of Hahn, Hallett & Willcutt Machinery Co., and Frank Jaques, field service engineer for Charmilles Engineering Works Ltd., Geneva Switzerland, at this student chapter's April meeting.

Hahn and Jaques explained that the first "machining with a spark," in which the tool is actually an electrode, was probably in connection with broken tax extraction. At the present time, though, the main application of the spark erosion process is in the machining of dies. There is a definite advantage in this, the speakers declared, in that the die can be worked in the hardened state. The machining of super alloys is also being performed by the spark erosion process simply because such alloys are not machinable by any ordinary method. *—Buell L. Brown Jr.*

SPECIAL EVENTS

ASTE Semiannual Meeting	Oct. 8-10	The Chase-Park Plaza Hotels St. Louis, Mo.
McMasters On-Campus Conference	Oct. 24	University of Hamilton Hamilton, Ont., Can.

TRI-CITIES—Leslie C. Seager (third from left), national director from Salt Lake City installed officers of Chapter No. 23 at Rock Island, Ill., meeting. Left to right are Louis Benson, secretary; Don Johnson, second vice chairman; Seager; Al Vande Walle, past chairman; Robert Larson, chairman; Clifford Vogt, first vice chairman; and Lester Youngberg, treasurer. *—Mel Swan*

DETROIT—Examining a double-head setup used to bore spindle drums for Warner & Swasey multiple spindle automatics are a few of the 250 Detroit Chapter members who visited the Warner & Swasey Co. during their "Out-of-Town Plant Tour" to Cleveland on April 10. An afternoon at Tocco Div. of The Ohio Crankshaft Co. with ASTE Past President Harry B. ("Doc") Osborn as host was also on the schedule.

—C. Francis Wrobel

CHAUTAUQUA-WARREN—New officers (left to right) are E. W. Garrison, chairman; Paul E. Anderson, first vice chairman; Clifford A. Bergquist, second vice chairman; Robert D. Swanson, secretary; and Robert Philblad, assistant secretary-treasurer. Not present was Karl Pierson, treasurer.

New Chapter Officers Named

LEXINGTON: Albert H. Payne, chairman; John C. Balk, first vice chairman; Ralph M. Thomas, second vice chairman; Douglas B. Tuttle, secretary; John D. Hartley, treasurer.

NORTH SHORE: Salvatore Gianino, chairman; H. Harold Hansen, first vice chairman; Charles H. Sylvain, second vice chairman; Russell G. Cameron, secretary; Herbert J. Comeau, treasurer.

KALAMAZOO: Ted Cook, chairman; Grant E. Beilfuss, fist vice chairman; Robert Ronningen, second vice chairman; Bud Hanshue, secretary, William T. Erickson, treasurer.

LITTLE RHODY: Karl Friedland, chairman; Bertrand Guindon, first vice chairman; Richard Kilbane, second vice chairman; Maurice Schoos, secretary; Harold Nihill, treasurer.

YORK: Richard Streitmiller, chairman; Donald Rohrer, first vice chairman; Thomas McMaster, second vice chairman; Charles Flaharty, secretary; Harry Seville, treasurer.

FOND DU LAC: Walter B. Wigton, chairman; William Warren, first vice chairman; Wayne Rowan, second vice chairman; Newman Reque, secretary; Farrell Sickel, treasurer.

AKRON: Harold Hawk, chairman; Clyde Fagan, first vice chairman; Walter Stine, second vice chairman; Joe Giordalis, secretary; Joe Koza, treasurer.

HAMILTON DISTRICT: W. E. Durrant, chairman; Oreland McIntyre, first vice chairman; Ronald Tipping, second vice chairman; Russ Wilson, third vice chairman; Howard J. Boucher, secretary.

MONMOUTH: Michael Lettieri, chairman; Harry Williamson, first vice chairman; Carl Anderson, second vice chairman; Bob Herpich, secretary; Peter LaPlaca, treasurer.

OAKLAND COUNTY: Lyle Hope, chairman; C. E. Brown, first vice chairman; C. T. Gaffney, second vice chairman; Neil Martin, secretary; Walter Morris, treasurer.

LANSING: Harvey Robey, chairman; Robert L. Knowles, first vice chairman; Leonard Sear, second vice chairman; Arthur Reiser, secretary; Layton Rugh, treasurer.

ROCKFORD: Ernst Norrman, chairman; Walt Lewis, first vice chairman; Les Monson, second vice chairman; Nels Balestri, secretary; Les Teachout, treasurer.

RACINE: Byron Peterson, chairman; John Kellogg, first vice chairman; Ray Knapp, second vice chairman; Art McCallum, secretary; Art Cherkinian, treasurer.

NORTHERN MASSACHUSETTS: Herman A. Wojdylak, chairman; John W. Turton, first vice chairman; Raymond E. Clement, second vice chairman; William T. McBride, secretary; John D. Sinclair, treasurer.

JACKSON: Julian Van Maele, chairman; George Hadden, first vice chairman; Walter Walker, second vice chairman; Clifford McArthur, secretary; Norman A. Peterson, treasurer.

ATLANTA: Charles Bolden, chairman; Ray Culver, first vice chairman; George Carson, second vice chairman; William Matthews, secretary; Paul Kight, treasurer.

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Positions Available

COLLEGE INSTRUCTORS NEEDED—Expanding two-year College of State University of New York seeks full-time teachers in both ELECTRICAL and MECHANICAL TECHNOLOGIES. B. S. necessary . . . Master's degree and/or teaching experience helpful. Salaries for those with advanced degrees and industrial experience start above $7000. Write to: W. R. Pulhamus, Head, Electrical Technology Dept. or B. G. Davis, Head, Mechanical Technology Dept. MOHAWK VALLEY TECHNICAL INSTITUTE, 751 State Street, Utica, New York.

SALES ENGINEER WANTED—Well-established and growing company manufacturing machine tools wants a Sales Engineer for Michigan and Ohio to live in Detroit. Experience in operating machine tools necessary, but selling experience is not. Salary, expense, and bonus. Write to: Box 146, News Dept., The Tool Engineer, 10700 Puritan Ave., Detroit 38, Mich.

QUALITY CONTROL ENGINEER—Graduate mechanical engineer, age 30-45 with heavy experience in all gaging equipment and techniques, to head up and supervise an inspection department and do field work in connection with our customer needs and problems. We are a well known national organization with headquarters in a Northwest suburb of Chicago. Send complete resume of experience and education. Write to: Box 147, News Dept., The Tool Engineer, 10700 Puritan Ave., Detroit 38, Mich.

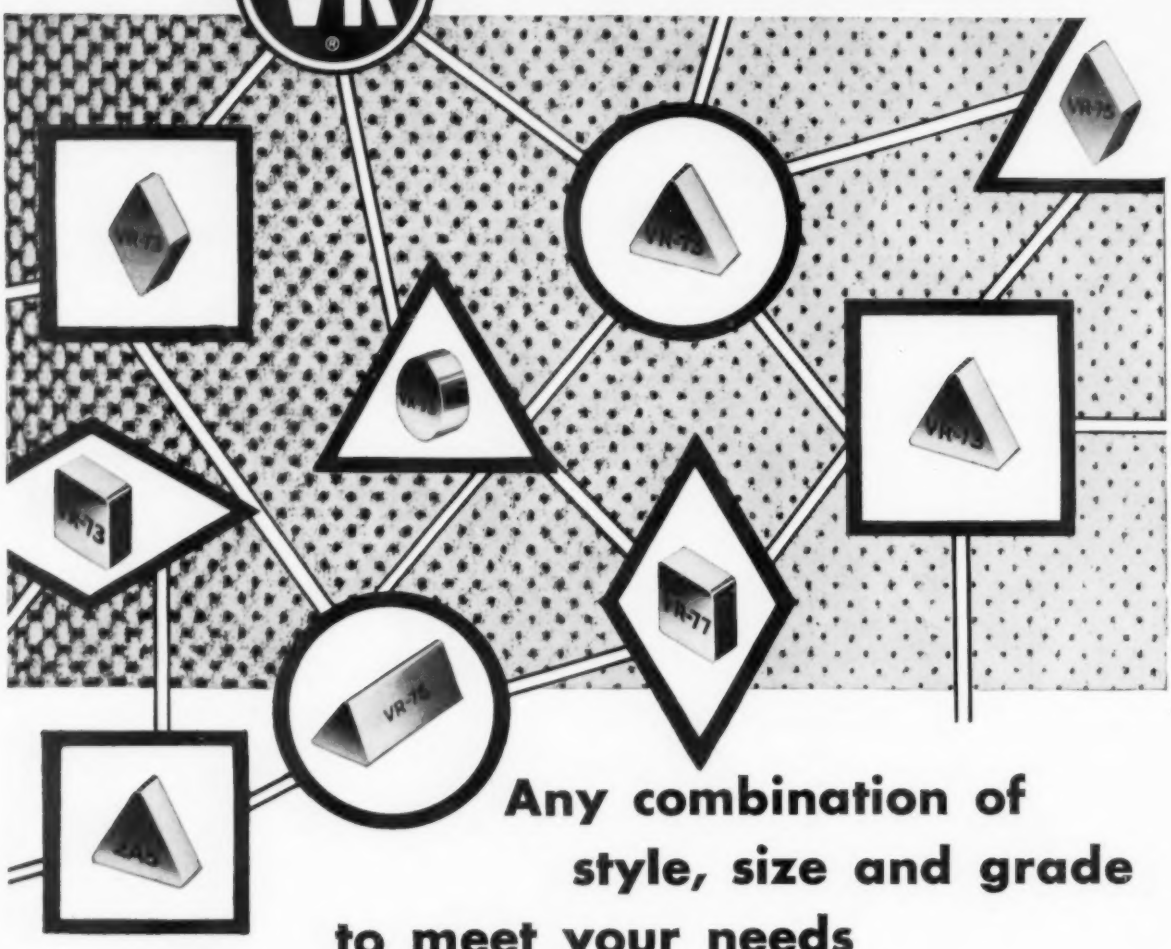
TOOL ENGINEER—with approximately 10 years' design experience on blanking, punching and forming dies. Must have practical background and good knowledge of modern fabrication methods. Attractive offer for qualified men in progressive sheet metal fabricating plant located in Eastern Pennsylvania. Correspondence confidential. Write to: Box No. 141, News Dept., The Tool Engineer, 10700 Puritan Ave., Detroit 38, Mich.

Positions Wanted

SALES ENGINEER—For cutting tool and machine tool manufacturer. Southern California, preferably San Fernando area. Ten years' experience in all phases of manufacturing, including: plant layout quality control, methods, some tool design, machine parts and sheet metal fabrication. A graduate of General Machinist Apprenticeship; some sales experience and college education. Aggressive and readily adaptable to new situations. Will furnish resume to interested parties. Address replies to Box 145, The Tool Engineer, 10700 Puritan Ave., Detroit 38, Mich.

MANUFACTURERS REPRESENTATIVE—Extensive and varied experience, 15 years, carbide tool design, application and service. Tool Supervisor several large companies. Presently represent one mfgr. of single point and T A insert tools. Desire only one other outstanding manufacturer of T C rotation tools. Northern N. J. or Metropolitan N. Y. Area. Write Box 148, News Dept., The Tool Engineer, 10700 Puritan Ave., Detroit 38, Mich.

V-R carbide inserts...



Any combination of style, size and grade to meet your needs

V-R Elevator Type Toolholder.

V-R Solid Base Type Toolholder.

Complete machining flexibility is possible only when you can get exactly the right combination of carbide insert grade, size and style . . . when you need it. That's why V-R manufactures the *most complete line* of inserts available anywhere. Regardless of the operation to be performed or the type of material to be machined, there's a V-R carbide insert that's best for your job. Ask your V-R representative. He will be glad to show you how V-R's complete line can provide fast answers to your cutting tool problems.

Send for Catalog VR-58 for complete details.

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PRIME MANUFACTURERS OF REFRACTORY METALS ENGINEERED FOR THE JOB

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Progress in Production

UTILIZE ULTRASONICS TO CHECK QUALITY

Hundreds of dollars are being saved at Bridgeport Brass Co. because of an ultrasonic resonance gage which provides a simple, fast and reliable nondestructive test method.

The company developed a rim-to-rim laminated structure for a line of kitchenware. An inner copper core, used for its heat conduction qualities, is protected by two outer stainless steel skins which serve to retain heat, and provide bright and easy-to-clean surfaces. The copper layer is laminated between two disks of stainless, the finished blank then formed by a press and buffed to a high gloss. Should there be any discontinuity in the bond, the blank may delaminate during drawing, or the defect may show up as a streak or blister after polishing. Should this occur, the shaped disk must be scrapped, which represents considerable loss of time and labor.

Incomplete bond shows up immediately on the cathode-ray screen. Traces on the screen are incomplete, or they may be differently spaced or absent completely. If the operator does not get expected test pattern, the disk is rerouted.

Three years ago, Bridgeport Brass installed a Vidigage ultrasonic tester to check the laminate strength before forming. The result has been materially reduced scrap losses due to bonding faults.

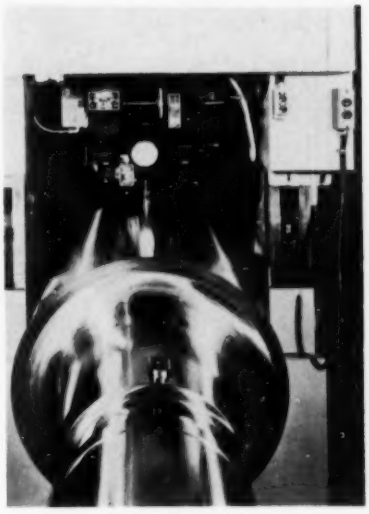
Immediately after laminating, blanks are inspected with the Branson Instruments device. Each blank is coated with a thin film of oil or glycerine for good sonic energy transmission. On a 17½ in. disk, the inspector hand checks about 60 points in a spiral pattern. The 12-in. disk requires 30 to 40 test points. If defect is indicated, the inspector marks it for special handling.

A single operator handles random production testing.

UNIVERSAL TESTERS CHECK STEEL HARDNESS

In a continuing effort to its production of forged steel rolls, Union Electric Steel Corp. has evolved an accurate and efficient method for hardness testing. With the cooperation of Wilson Mechanical Instrument Div., three successive testing arrangements were developed and set up. The most recent, installed last year, is a universal type with a 16-in. vertical capacity. It is mounted on the crossrail of an outmoded Niles-Bement-Pond milling which has a vertical travel of 0 to 56 in. Bed of the miller is 24 in. wide by 20 ft long. Distance between columns is 38 in., permitting the unit to accommodate a 38-in. diameter by 12 ft long roll body.

After the mill roll has been removed from the tempering furnace, a scale free testing surface about one inch wide and the full length of the body is prepared. The roll is set in Vee blocks of the testing machine bed by a crane hoist, and positioned under the indenter by the machine's motor drive unit. On the milling machine setup, any vertical movement under 16 in. is taken care of by the testing unit's drive; excess is taken care of by the crossrail drive.



When the diamond C-Brale penetrator is about ⅛ in. from the roll's testing surface, a limit switch cuts out the down drive. A hand crank brings the indenter into contact with the roll and applies minor load. The operator sets the dial gage and trips the crank to apply the major load. When the dial pointer comes to rest, the major load is removed with the same crank. Rockwell reading of the roll is read directly on the dial gage. The minor load is removed to allow repositioning of the roll.

Not only can the complete testing cycle be accomplished in a relatively short time, but these readings which have been taken in a shop are as accurate as Rockwell readings taken in a laboratory.

METALWORKING INNOVATION GIVES FASTE FABRICATION

Complete and instant fabrication of such shapes as faucet handles and hubs and spokes of a steering wheel has come into the picture with an unusual metalworking technique. Lateral impact

● ACTUAL MANUFACTURERS OF RESINOID METAL AND VITRIFIED DIAMOND WHEELS UP TO AND INCLUDING 24" DIAMETERS

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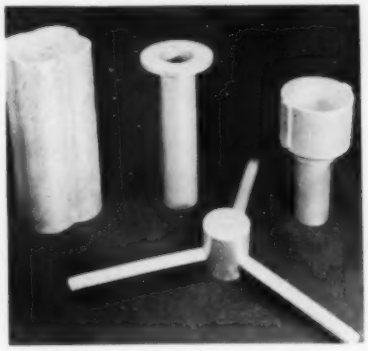
INDICATE A-6-142

extrusion, as it is called, is a modification by Aluminum Co. of America of the impact process. "Lateral" part of the term refers to direction of metal flow. Impacts previously have been produced as a result of metal flow up around a punch, down into a die, or a combination of these. Lateral impact adds the potential of metal flow outwards at any angle from direction of the impact stroke.

In developing the technique, Alcoa proved the process by designing a part similar to the center and spokes of an automobile steering wheel. The part, consisting of a formed hub with three spokes extending outward from the hub near its center, is produced in one operation, cold, from a cylindrical slug.



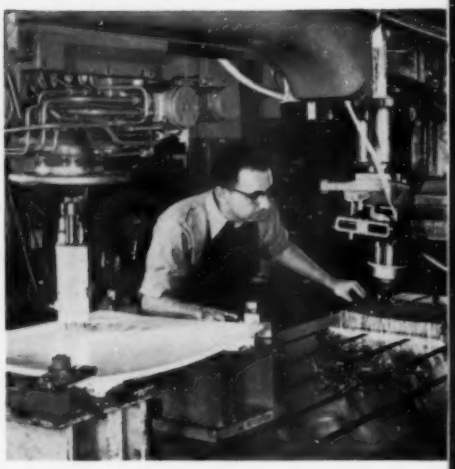
Lateral impact extrusion produced the spoked part quickly and economically. The other parts were produced by conventional impacts. From left, techniques represented are: Reverse impact, made by metal flow up around a punch; forward impact, made by metal flow down into a die; combination impact, made by metal flow both upward around a punch and down into a die.

Observation of the operation and its results seems to show that it will permit economical production of parts that combine an intricate hub or core with lateral extensions as spokes or vanes. Such a part would be free of porosity and brittleness and have toughness and high wrought strength throughout.

MOVING HEAD SIMPLIFIES HONEYCOMB MACHINING

Machining of honeycomb structures for aircraft and missiles got a hula switch because of an unusual invention at The Martin Co.

New equipment, called a Hula head, is capable of machining compound contour structural shapes from honeycomb core material within required tolerances and finish without the use of a filler substance designed to rigidize the sandwich-like core during machining.



The unit involves a standard three-axis controlled cutting machine equipped with a portable head and a modified stylus able to convert the cutting to a five-axis operation.

During cutting, the stylus, which has five pickup points, rides the surface of a wooden or plaster contoured model and transmits rise, fall, and tilt motions to the cutter head. Knife edge on the cutter head performs duplicate motions in cutting the honeycomb core.

The cutter head is capable of tilting ± 10 deg in two directions, perpendicular to each other, and there is a common focal point on the center line and end of the cutter. Tracer controls consist of a combination of pneumatic, hydraulic and electronic components. Power is supplied by an air motor developing 12,000 rpm.

SUCTION HELPS STACK THIN METAL

Thin material presents a particular plant problem when it involves stacking.

One of the operations at Westinghouse's air conditioning plant in Staunton, Va. is punching aluminum fins for fin and tube type heat exchangers. Originally the fins were made from 13-mil thick material which was run through a punch press die in single strips, cut off to length and gravity fed down a chute into a stacker where they were loosely aligned. When the material was replaced by thinner 7-mil thick aluminum, made by shearing multiple strips of material in the die, the old method did not work properly because the aluminum lacked rigidity and weight.

Engineers solved the problem by determining that the new aluminum strips will drop and stack as required if there is no lateral motion of the strip at the point of drop. An overhead suction

mechanism which was adapted to the automatic punch press now catches the aluminum strips after ejection from the press and held while the press feeds the desired length of fin. The strips then are dropped vertically as the vacuum is momentarily broken. The fins drop onto guide rods until the correct number is obtained. A new set of guide rods then are indexed into position and the machine automatically begins again.

ULTRASONIC CLEANERS GET MODULAR DESIGN

The building block technique has been extended to the cleaning field with development of a new line of ultrasonic cleaners by the Vibro-Ceramics Div. of Gulton Industries, Inc. Because its engineers have solved the impedance matching problem, the company's equipment permits interchange of tanks and generator. In the modular construction of the line of 13 cleaners, five separate tank sizes and six preset generators are used. As a result, units are "custom fitted" to operate at peak efficiency over the full range of industrial applications.

According to Irwin I. Steinberg, division general manager, "In almost all cases three different ranges of cleaning efficiency (light, average, heavy) are available. A prime characteristic of the line is the side mounting of the transducers which provides maximum in cleaning efficiency since varying water levels and physical loads tend to create mismatches of impedance in bottom-mounted cleaners. High temperature ceramic transducers, are capable of operating at 350F. The cleaning tanks are available in ½, 2½, 16 and 25 gallon sizes. Generators are preset at 50, 100, 200, 500, 1,000 and 2,000 watts.

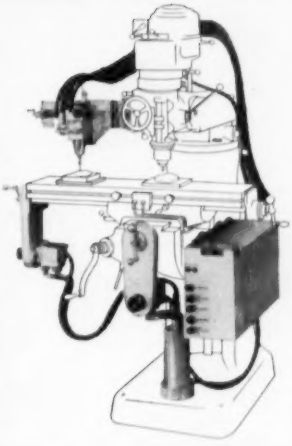
SYNCHRO-TRACE—FULLY AUTOMATIC 3D PROGRAMMED CONTROL SYSTEM CUTS COST OF DIES, MOLDS AND CONTOURED PARTS BY OVER 50%.

Now—Produce dies, molds and contoured parts faster, with greater accuracy using Synchro-Trace duplicating attachment with your milling machine. Synchro-Trace fully automatic operation allows operator, formerly required, to perform other important duties. Costly benching time reduced as much as 50% due to uniform feed rate, high tracer accuracy, and the even amount of "pick" with each pass of the cutter. Accurate estimates of machining time required may be made, as cutting path, feed, and amount of cut are pre-determined for every pass of the cutter.

Synchro-Trace will duplicate any shape of part—even 90° walls. Other features include "pick" feed in either direction, fixed stylus oversize, automatic shutdown, plus many others.

Synchro-Trace may be purchased as original equipment on new mills or adapted to existing tool room, production, and planer type milling machines.

Contact your nearest True-Trace dealer or direct factory branch plant TODAY for further information on how Synchro-Trace can cut your 3D contouring cost.



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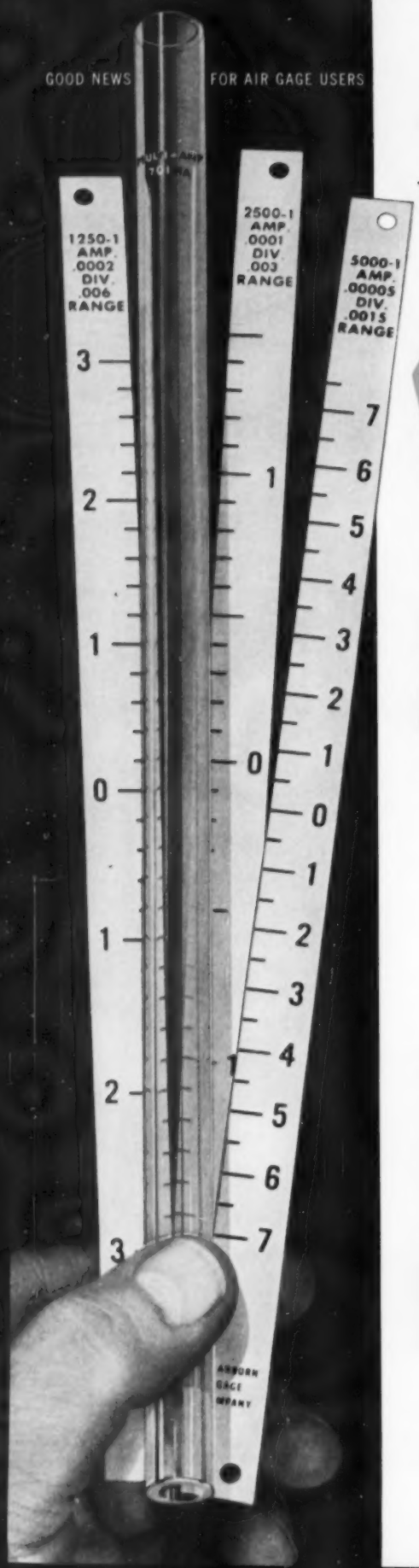


Just 1 tube serves three amplifications

. . . and it's available now exclusively with

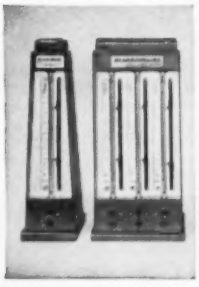
Dearbornaire

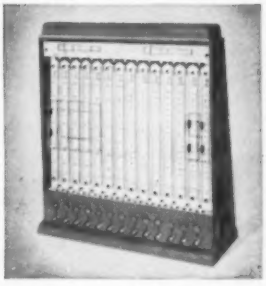
Column-Type Air Gage Instruments

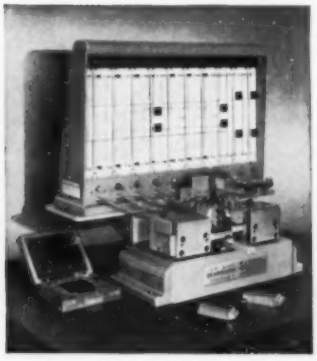
No fussin' around with single-purpose parts! Now, with Dearbornaire's new "Multi-Amp" Tube, you can convert an instrument from one amplification to another simply by changing calibrated scales. What's more, this unique new tube has a "characterized" variant rate of internal taper which . . .

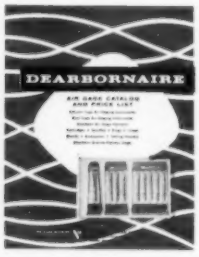
1. Creates an air circuit that is truly linear over the full extent of the calibrated scales to give you finer accuracy of measurement. 2. Permits greater clearance between tube wall and float, thus minimizing down-time for cleaning and maintenance. 3. Allows up to three times greater total element gaging clearance to reduce wear, extend life, and cut gaging costs.

Dearbornaire Instruments are offered as single or multiple column units in amplifications of 1250-1, 2500-1, 5000-1, and 10,000-1 or in any combination thereof.









New Catalog contains complete price information on Dearbornaire Instruments and Air Gage Cartridge Spindles, Rings, Snaps and Fixtures. Send for your free copy today!

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TOOLS of today

Forming Machine

Cylindrical workpieces such as tubes or rings can be cold formed to obtain profiles on the inside diameter with use of the Intraform chipless machining equipment.

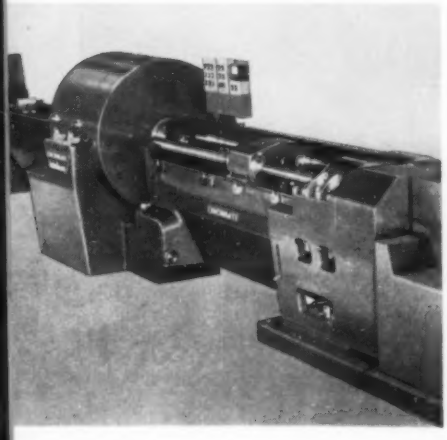
Four forming dies pulsate rapidly while revolving around the OD of the work, squeeze the work after a mandrel has been inserted to reproduce the profile of the mandrel in the ID of the part. A smooth, continuous squeezing action occurs more than 1000 times per minute.

Intraform forming can be applied to any type of ferrous or nonferrous parts ranging from about ⅛ to 5 in. diameter, and made from premachined blanks, tubing, castings, forgings or extrusions. In addition to forming profiles in open or blind holes, laminated tubing can be made by form-bonding two or more metals. The bond is unusually strong and tight. Forming operations also may be performed on tubular and solid work without a mandrel for pointing, reduction of diameters, and forming of taper and radius.

Finishes resulting from the process are good. Rifle barrels, for example, have a 32-microinch finish after drilling and reaming. After the Intraform operation, which forms the rifling, the finish averages seven to eight microinches. For accuracy, some types of parts have been held to 0.0002 in. limits for the ID profile.

Tests indicate tensile strength can be improved as much as 30 percent.

Meta-Dynamics Div., The Cincinnati Milling Machine Co., Cincinnati 9, Ohio. **T-6-1**



Magnetic Inspection Equipment

Surface and subsurface defects in ferrous metal parts and assemblies can be detected by the Detectascope magnetic system. After inspection, the unit also demagnetizes the part.

The portable equipment locates invisible discontinuities such as deep subsurface cracks, laps, voids, grinding, welding and heat-treating cracks even through painted or plated surfaces without damage to the part or danger to operator.

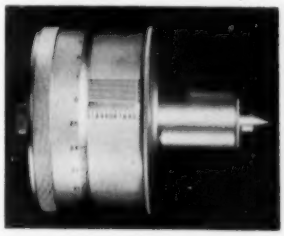
It consists of removable electromagnet and demagnetizer unit with handle, extension cord and foot switch; black light hood assembly, transformer, 5 gallon tank, agitating pump, and voltage regulator—all mounted on a mobile cabinet. The unit plugs into a 110 v outlet.

The electromagnet is placed on the part to be explored, or small parts may be brought to the electromagnet station. Current is turned on with foot switch, and the area to be inspected is painted or sprayed with an oxide solution from the tank. Iron particles in the solution concentrate wherever there is a defect. The part may then be demagnetized with the same unit.

Ferro Machine & Tool Co., 5514 W. Washington St., Indianapolis 41, Ind. **T-6-2**

Micrometer

Accurate to ±0.000010 in., this micrometer is available in two standard size ranges: 0-1 and 0-2 in. To facilitate reading, it has a 4-in. diameter barrel. They can be made to suit special requirements with graduations on the thimble and barrel arranged for



reading right or left, normal or reverse. Lead screw, nut, and barrel of each micrometer are calibrated as an integral unit at the Eli Whitney Metrology Laboratory, and the serial number registered.

Two other micrometer models of this type also are available. One is made to an accuracy of ±0.000015 per inch and the other to ±0.000020 per inch.

The Sheffield Corp., Dayton 1, Ohio. **T-6-3**

Numerical Control Equipment

Designed for switchable simultaneous continuous control of 3 out of 4 motions of rigid, high accuracy 4-axis milling machines, this machine control unit offers the additional feature of being able to switch from a linear motion to a rotary table or tilting spindle.

Command pulse values from the control unit to the machine tool of from 0.0002 to 0.000025-in. can be achieved.

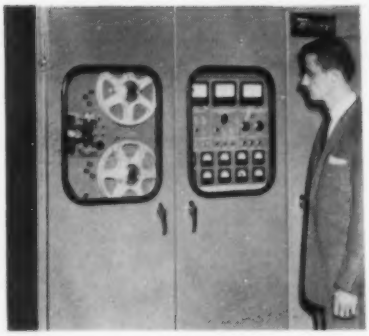
Input to the control unit is punched tape. The high-speed tape reader per-

mits tape reading of 300 lines per second in the forward direction and 600 lines per second in the reverse direction.

An automatic tape rewind feature allows the operator to remove the part as the tape is being rewound.

A decimal display position indicator with continuous readout of position location of any axis is incorporated in this machine control unit. The position indicator assists in setup operations.

Four auxiliary tape control functions are also available to automatically control coolant flow, spindle speed, tool changes, table indexing, chip conveyor, etc.



A feed rate override feature allows the programmed feed rate to be reduced to as little as 20 percent of the programmed rate. Such variables as cutter quality, material hardness, vibration from fixture or tool, or a too high programmed feed rate can be taken into account without remaking the control tape to provide reduced tool loading in critical areas.

Symmertcial parts can be made simply and easily from the same control tape. A reversing circuit provided for each axis effectively complements or reverses direction of machine motion from that specified on the tape.

Industrial Controls Section, Bendix Aviation Corp., 21820 Wyoming Ave., Detroit 37, Mich. **T-6-4**

USE READER SERVICE CARD ON PAGE 169 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Broaching Machine

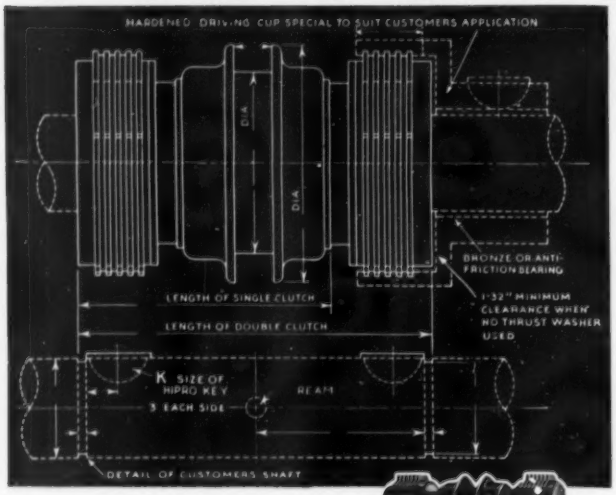
The Eager Beaver pull-down broaching machine, built with a 12-in. stroke, is rated 1½ ton at 5 fpm broaching speed, and ¾ ton at 10 fpm. Standard equipment comprises two cutting speeds and mechanism for adjusting the stroke. Tooling, coolant system and electrical equipment are extra.

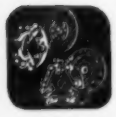
This bench size broaching machine is only 31 in. wide, 20 in. front-to-back

and 34 in. high. Hole in the drawhead is 1½ in., the hole in the platen is 5 in. and the platen dimension is 17 x 18½ in. The self-contained, portable machine can be plugged into any 110 v outlet. Designed for an automatic broach puller and coolant, it has a mechanical screw type drive with all moving parts lubricated.

The Lapointe Machine Tool Co., Hudson, Mass. **T-6-5**

ROCKFORD

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Precision machining and grinding, proper hardening and the symmetrical contours of PULLMORE Multiple-Disc CLUTCHES insure perfect balance and smooth operation at both high and low speeds. Because of this close-tolerance construction and compact design the powerful pull of PULLMORE CLUTCHES is not affected by centrifugal force or the direction of rotation. They handle loads of greater capacity when operated at high speeds. Can be used both to drive and as a brake.

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CLUTCHES

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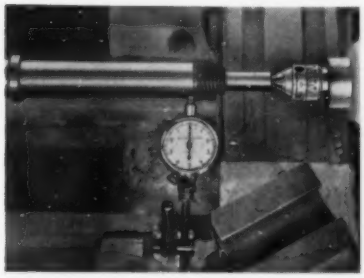
Adjustable Center

The Micro Set adjustable center permits quick, accurate center alignment on old or new machines without tailstock jogging for precision or taper turning. Corrective movement of the work held between the lathe headstock and the adjustable center is accom-



plished by an equally eccentric ground sleeve and arbor, which complement each other when assembled and produce lateral movement of the ground and hardened tip in increments of 0.001 in.—increments are read directly on the sleeve. Total tip movement in either direction is 0.006 in.

The center is currently available in No. 2, 3 and 4 Morse Taper.

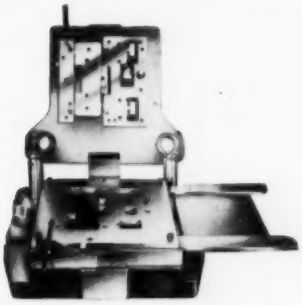
Enco Mfg. Co., 4520 W. Fullerton Ave., Chicago, Ill. **T-6-6**

Air-Hydraulic Press

This Unipunch press Model 1012, equipped with precision Unipunch gaging and tooling, is capable of fast hole punching in angles, channels, extrusions and sheets plus notching operations. Available with the press are 37 round punches and 74 dies with 4 Unipunch hole punching units and one Unipunch notching unit, to provide rapid interchangeability of punches and dies for various hole diameters. The press also may be used for punching

Typical of problem parts that cause abrasion to tool parts is this electric range switch component. Greater formability of 200-PLUS means less abrasion —longer tool life.

TOOL LIFE INCREASED 30% OR MORE...



...with miller

200-PLUS PHOSPHOR BRONZE

*A leading manufacturer of wiring device assemblies reports: "Miller 200-PLUS phosphor bronze, with its great formability, has significantly reduced our need for tool sharpening, and all indications point to a greatly increased tool life. In addition, I get a more consistent part, with more uniform shape and springback."

The secret's in the 200% ductility increase of Miller 200-PLUS. Forming ability goes way up . . . tensile strength remains the same! The result is far less abrasion than with other phosphor bronzes in spring temper—and tools that last one-third longer!

**Name and case history on request*

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THE MILLER COMPANY
MERIDEN, CONN.

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extruded and countersunk holes, small louvers, and lanced holes; small die sets may be installed for making stampings. Threaded nut inserts also may be pressed into sheets or parts. Heeled punches and dies are available for "hogging" out holes and shapes larger than 2 in. diameter.

With a template, several hole punching units may be set up for making a cluster hole patter.

Four sets of hole punching equipment and accessories are available.

Air-hydraulic design of the Model 1012 offers minimum moving parts, and all-welded construction. It operates at 10 tons capacity from 65 to 75 lb airline pressure. Ram adjustment provides for varying daylight openings and permits a wide range of press operations. Positive action from foot control to ram release prevents double stroking. Throat depth is 15½ in. without gaging.

Equipped with built-in scales, precision gaging assures accurate location of holes and notches in the work. Hole punching and notching units may be mounted quickly and interchangeably on the gaging base plate. Standard Unipunch gaging is 24 in. from center of ram to the left, and front to back 12 in. Over 24 in. long gaging available. Six regular stops and one close edge stop are supplied as standard.

Punch Products Corp., 3800 Highland Ave., Niagara Falls, N. Y. **T-6-7**

Geneva Drives

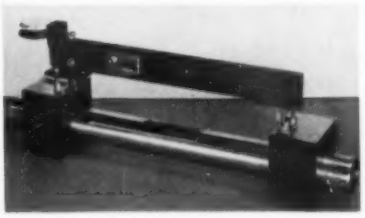
Standard Geneva drives are available with 3 to 24 indexing stations for shaft center distances from 3 to 6 in. in ¼ in. increments in a variety of hub and bore diameters. Steel wheels have Meehanite driving wheels. The drives in-

corporate precise design to assure proper performance, accurate indexing, positive locking, and smooth, trouble-free operation. Center distances less than intermediate or greater than the standard 3 to 6 in. range also are available.

Genevamatic Engineering Corp., P. O. Box 10386, Tampa 9, Fla. **T-6-8**

Length Gage

This adjustable length measuring indicating gage may be changed from ID to OD by moving the indicator or rest pins to different positions in the gage. Standard units have a maximum meas-



uring depth of 1.000 in., and a length range from 0 to 54 in. Fixed ID and OD masters are available to set the gage.

Size Control Co., 2500 W. Washington Blvd., Chicago 12, Ill. **T-6-9**

Slicing Machine

The Microtom-atic slicing machine, Model MTA-7, is practical for slicing hard or brittle material accurately at high-production rates. Thickness of the slices is limited only by the cutter width and by the material characteristics. Index is achieved by a cross-feed mechanism of high repetitive accuracy; while adjustable variable spindle speed permits exact balance of optimum cutting factors for maximum performance.

The new cross-feed mechanism, combining hydraulic and mechanical principles, is set with a handwheel gradu-

UNITRON offers a 3-D stereoscopic microscope for as low as $110

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MSL *A precision, budget-priced instrument for industrial, laboratory and educational use. Invaluable for inspection, assembly, quality control and dissecting.*

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- rack and pinion focusing with intermediate dovetail slide to accommodate large specimens
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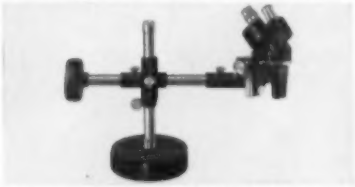
(*$120 for model with 1X objective.) Additional eyepieces $19.50 per pair. **Only $110**

MSHL *A versatile, general purpose instrument with a wide range of magnifications. A high-stand model with mirror substage for transmitted light is also available.*

- inclined binocular body with interpupillary and diopter adjustments
- sturdy stand with glass stage plate and reversible background contrast plate. Cabinet and dustcover
- revolving nosepiece for rapid interchange of objectives
- rack and pinion focusing with two intermediate dovetail slides to accommodate large specimens
- optics: coated lenses and prisms . . . Model MSHL-1 includes 1X, 2X, 3X, paired objectives; 8X, 12X, 15X paired wide field eyepieces

Model MSHL-3 with paired objectives 1X, 3X, 6X and eyepieces as above: price $275 **Price $267**

Prices f.o.b. Boston — Quantity discounts available



ACCESSORY VERTICAL PILLAR STAND

For use with binocular head and focusing mechanism of either Model MSL or MSHL. Facilitates the examination of large objects and extended areas. Sturdy, counterbalanced arm has both horizontal and vertical travel. Two independent angular motions of the binocular head permit orientation in any desired direction. **Price (stand only) $75**

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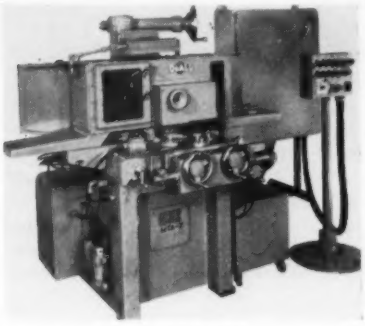
ated in tenths for any automatic index from 0 to 0.100 in.

A flat belt connects the spindle to a 1½-hp dynamic eddy-current drive providing infinitely adjustable speeds from 5,000 to 10,000 rpm. This is particularly useful when cutting extremely thin slices of hard, frangible material, because of the critical cutting speed for the optimum production rates. With the MTA-7, this rate can be quickly determined.

A motorized rotary fixture uses a drawback collet chuck for rapid load-



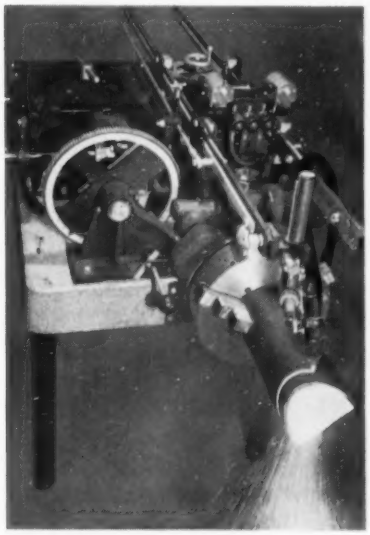
ing. Speed of rotation, from 20.5 to 164 rpm, is controlled from the machine control panel. By turning the crystal during the cutting, the wheel need only traverse half the crystal thickness.

The DoAll Co., Des Plaines, Ill.

T-6-10

Flame Cutting Machine

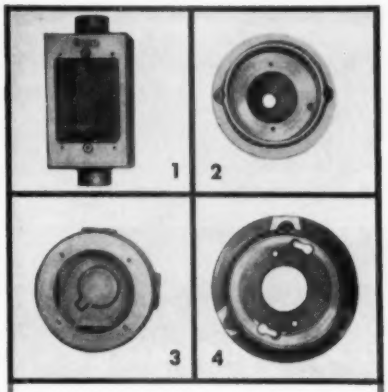
This automatic contour cutter cuts at a rate of 20 ipm; it will contour a 6-in. aluminum pipe in only 20 seconds. Initial setup takes as little as 15 seconds. Pipe is clamped into a 3-jaw chuck and pertinent information fed into the controlling mechanism. Pushing a button



Get Adjustable Head Flexibility with ZAGAR Fixed Center Heads for Drilling, Reaming and Tapping

● ***ADD SPINDLES***
AT REDUCED COST PER SPINDLE

● ***INCREASE PRODUCTION***
AT REDUCED COST PER PIECE



PART 1: Spindles 3, 4, 5, 14, 15, 16
PART 2: Add Spindles 2, 7, 10, 12
PART 3: Add Spindles 9, 11
PART 4: Add Spindles 1, 8, 13

When 16 Spindles to Produce 4 Pieces Are Used—

- Cost Per Spindle **REDUCED 50%**
- Cost Per Piece **REDUCED 66%**

This simple illustration proves Zagar's point — that production is in direct proportion to number of spindles used. With the Zagar *gearless* principle, holes on any center can be drilled, reamed or tapped. With fixed center heads, you eliminate many hazards of drilling by other methods. Yet you get a flexibility unmatched by any other equipment.

Write for cost details on print "E-6".

Zagar

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23892 LAKELAND BLVD.
CLEVELAND 23, OHIO

TOOLS FOR INDUSTRY and SPECIAL MACHINERY

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activates the action and the contour is cut without templates, layouts or patterns. Sections requiring straight, mitered or contoured ends are quickly prepared with proper bevels for welding. The cutting head is equipped with an oxyacetylene torch for cutting carbon steel or a Linde Heliarc for cutting other metals.

A companion piece is available for cutting holes, circles and elipses. Various models of the machine allow the operator to handle pipe from 2 in. up to 24 in. in diameter.

Steffan Mfg. Corp., 276 S. Lincoln St., Salem, Ohio. **T-6-11**

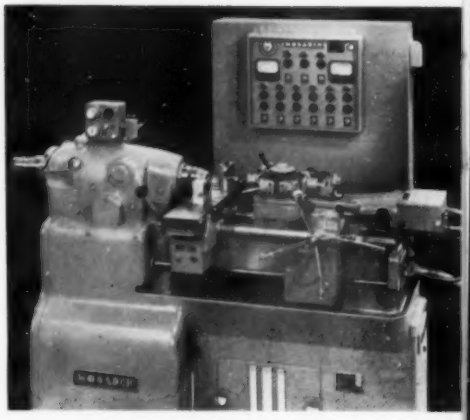
USE READER SERVICE CARD ON PAGE 169 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Hand Screw Machine

Designed for higher output and accuracy, the Speedi-Matic hand screw machine is suited for lots ranging from less than 25 to more than 2500 pieces. It incorporates simplified electronic controls and a hydraulically powered turret.

The control center provides preselected, automatic speed and feed change so that a separate speed may be preset for each of the six turret positions (including a reverse speed for tap withdrawal) and for each of the two cutoff and forming slide positions. Speed range is infinitely adjustable from 40 to 4000 rpm; feed range is infinitely adjustable from ⅛ to 16 ipm.

Also included in the control center



are a feed indicator, a dual rpm and fpm indicator and a work diameter selector. The indicators enable the operator to select quickly the correct speed and feed for each work station. Use of the work diameter selector provides the ideal surface cutting speed without the usual calculations. Setup is fast and simple.

As the power feed, ram type turret is manually retracted, it is indexed, located in the new position to an accuracy of less than 0.0002 in., and clamped in position—all hydraulically. Retraction of the turret farther than the index position permits manual rotation of the turret head. An adjustable, positive length stop for each turret position allows quick setting for exact depth of cut. Working stroke of the turret is 5 in. The feed box is powered by an electronically controlled feed motor.

Monarch Machine Tool Co., Sidney, Ohio. **Request information on company letterhead.**

Tape-Controlled Miller

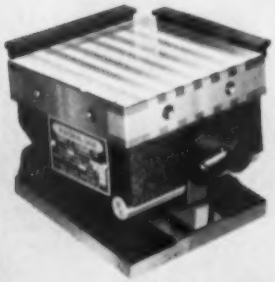
Regular and irregular shapes can be continuously and accurately milled in three dimensions under direction of tape-reading numerical control with the Numeric-Keller machine.

Horizontal and transverse movements of the table on which the work is mounted, vertical movement of the cutter spindle, and feed rates are automatically controlled by punched tape. The operator pushes a button to start the tape, changes tooling as required, and sets spindle speeds. The machine is practical for both short and long-run production.

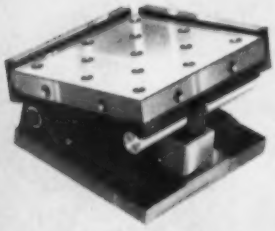
The machine is run at maximum speeds and feeds during all phases of the cycle. The smooth, calculated, continuous path of the cutting tool results in excellent surface finish on the part. Both automatic roughing and finishing cycles can be coded into the tape to provide for final skin cuts. Symmetrical

NEW SMALL SIZE

LOWER COST, FASTER ACCURATE ANGULAR SET-UP OF SMALL WORK



Magna-Sine (Model B-3-MS) With 4" x 4" Working Area



Sine Plate (Model B-3-SP) With 4" x 4" Working Area

ROBBINS MAGNA-SINE

This new smaller Magna-Sine has all the time-saving, accurate angular set-up features found in larger Robbins Magna-Sines. Small to medium size work can now be set up in minutes instead of hours and with a lower investment in equipment. Magna-Sine table has a strong, fine pole, permanent magnet chuck that firmly holds small work without distortion.

ROBBINS SINE PLATE

Robbins small Sine Plate is manufactured to the same high standards of accuracy as the Magna-Sine. This precision makes it ideally suited for angular inspection set-ups. The ground surface of the non-magnetic table has tapped holes for convenient clamping of any work. Also, sturdy construction makes this small Sine Plate extremely suitable for light machining operations.

Compound angles are quickly and easily set up with this Robbins equipment by combining either two Magna-Sines, a Magna-Sine with a Sine Plate, or two Sine Plates. Now, with lower initial investment, every shop can secure accurate angular set-ups for small work. With Robbins equipment, you do a better job, faster and at less cost.

OMER E. Robbins COMPANY
11961 DIXIE AVENUE DEPT. E DETROIT 39, MICH.

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right and left-hand parts may be cut with the same tape.

The machine is equally capable of very heavy or delicate work. Eighteen spindle speeds range from 40 to 3600 rpm. Table travel is 36 in. horizontal and 12 in. transverse; vertical slide moves 22 in.; table working surface measures 48 x 30 in.

Various built-in control devices in the form of automatic error-detecting circuits and continuous digital feedback controls automatically shut down the machine if any malfunction is detected, or they adjust motions in case of errors. Jogging controls allow the operator to stop the machine, withdraw the cutter spindle, change the tool, return to machining position and continue under tape control without loss of synchronization.

Standard plug-in electronic packages can be quickly interchanged or replaced.

The operator can override the machine feed manually within a range of from 20 to 100 percent of the programmed feed rates. Continuous-position readout and jogging controls facilitate tool changes and machine setup.

Pratt & Whitney Co., Inc., W. Hartford 1, Conn. **T-6-12**

Toolholder

This quick change toolholder engages the tool post over a large high-finished, profiled cylindrical area. Because the area is independent of the locking mechanism, accuracy in all three coordinates is assured to 0.0001 in.

The toolholder block assembly engages the compound rest of the lathe with a large area which makes it an integral part of the compound rest. Tool bits are equipped firmly by the holder, ordinarily over the entire length. Center hole of the toolholder block is fitted with a soft bushing which can be drilled to size if necessary, to accommodate existing hardware.

Micrometer type vertical adjustment requires no tools, is simple and accurate.

Concord Engineering & Mfg. Co., 315 W. 9th St., Los Angeles, Calif. **T-6-13**

Drilling and Tapping

The Deka-Drill multiple-spindle drilling and tapping machine is available as manual model M-712, operated by hand or foot pedal, and hydraulic model H 712, (illustrated) a fully automatic cycle machine tool. At 60 fpm speed and 1½ ipm feed, the drilling capacity is as follows: Six ⅜-in. holes; ten 5/16-in. holes; or fourteen ¼-in. holes. At 75 percent thread, 20 ipm feed, the tapping capacity is five 5/16-18 taps; eight ¼-20 taps; twelve 10-32 taps; and fourteen 8-32 taps. Both standard models are capable of drilling and tapping up to and including a total of twelve holes; more spindles can be supplied on special order. To simplify knee operation, the machine incorporates a self-contained, manually operated hydraulic lift which raises the knee by means of a few short strokes. There is no need for crank and gear assemblies, bearings, handles, screws, etc. Opening the metering valve allows the table to glide smoothly downward at an infinitely controlled rate of speed.

Ram type, slide construction is used in support and actuation of the table and knee. When the table is extended its full six-inch travel, the ram is always engaged in the slide, to give rigidity throughout the entire stroke. The lower spindle arms are adjustable ver-

JUST a turn of the end on the adjusting rod and the stroke of this versatile O-M Cylinder is lengthened or shortened to fit the operation. This is accomplished with micrometer accuracy in a moment from the outside of the cylinder without disassembling or unmounting the unit or extra parts. Thus, you get the advantage of a special cylinder with no additional cost.

OTHER ADVANTAGES. Fits where others won't. All-steel construction with bearing surfaces of bronze. Designed right to seal right. Rod has high yield point. Can be disassembled and assembled faster than tie-rod types. Delivers continuous, smooth, dependable power at low or high speeds. Port can be oriented to any position. End plugs are tapped for universal mounting.

Available in a complete range of sizes (1½" to 8" bores) with standard, 2 to 1 or oversize rods. Also full line of mounting brackets interchangeable bore for bore. Immediate delivery on many sizes.

Mail coupon *TODAY* for Bulletin 112 featuring O-M Adjustable Stroke Air and Hydraulic Cylinders.

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You avoid wasted machining time, and save valuable stock by being able to lay out patterns that eliminate defective areas.

Whether your nondestructive testing problem involves raw material inspection, "in process" quality control or fully automated production line "go-no-go" checking, Curtiss-Wright has the equipment to fit the task and the engineering experience to help you establish inspection procedures.

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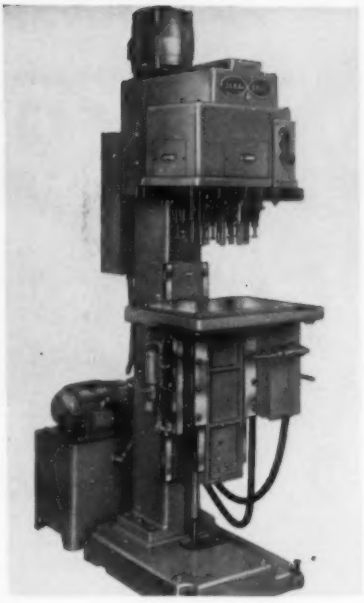

tically a full 1 5/16 in. The upper spindle arms on the Deka-Drill consist of two universal joints connected by a hexagonal driving shaft, with the shaft sliding in and out of one of the joints. Gearbox in the head of the Deka-Drill is completely self-contained, sealed and lubricated with the lubricant completely surrounding the mechanism.

Precision Tool Mfg. Co., 1305 S. Laramie, Cicero, Ill. **T-6-14**

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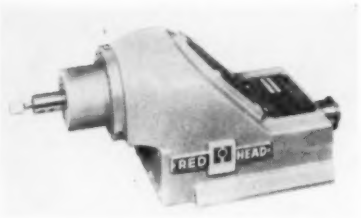
Belt-Driven Wheelheads

This interchangeable cartridge type wheelhead develops spindle speeds of 45,000 to 100,000 rpm for grinding small diameter holes where surface speed of the grinding wheel is critical. Because there is no need for high-



frequency generating equipment, the wheelhead permits economical single high-speed spindle installation.

One of the interchangeable spindle cartridges operates at speeds of 45,000, 52,000 and 60,000 rpm; the other at 70,000, 85,000 and 100,000 rpm. Three separate speeds for each cartridge are obtained by pulley change. Both car-

tridges have spindles arranged to accommodate mounted point wheels.

Base of cartridge interchange, and simplicity of changing from one speed to another within the range of each cartridge, make the application of high-speed, belt-driven wheelheads practical where frequent setup change-overs are necessary. The wheelheads are particularly suited to long production runs.

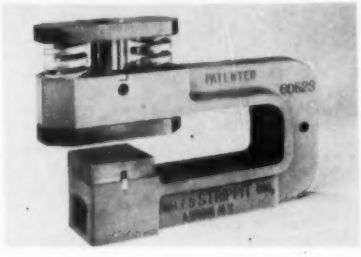
The basic wheelhead consists of a jackshaft and body unit and the spindle cartridge. A spring-loaded damped idler puts constant tension on the spindle drive belt; its design eliminates vibrations caused by idler bounce. The grinding spindle is oil mist lubricated. The wheelheads are built with 4-in. center height as standard.

The Heald Machine Co., 6 New Bond St., Worcester 6, Mass. **T-6-15**

Punching Tool

By changing stripping mechanisms, capacity in mild steel of this press actuated hole punching unit may be quickly altered from 0.250 to 0.750 in.

It consists of a single heavy-duty holder for both capacity ranges, and has a readily removable punch assembly, and two lift-out stripping springs. With mechanical springs in place, it has stripping pressure suitable for the



lower capacity work ranging from 0.250 to 0.500 mild steel; with Hydra-Springs, stripping pressure is greatly increased for work ranging from 0.375 to 0.750 in. in mild steel.

The punching unit also has removable round, obround, square or shaped punch tips and dies. The punch body is keyed to the holder to maintain accurate alignment.

Wales-Strippit, Inc., 211 S. Buell Rd., Akron, N. Y. **T-6-17**

Automatic Lathe

Incorporated in the Max Mueller high-production lathe is an Eltropilot universal program control that provides automatic machining of all types of workpieces.

It provides preset, automatic control of all tool movements on saddle, cross-slide, copy attachments, drilling units

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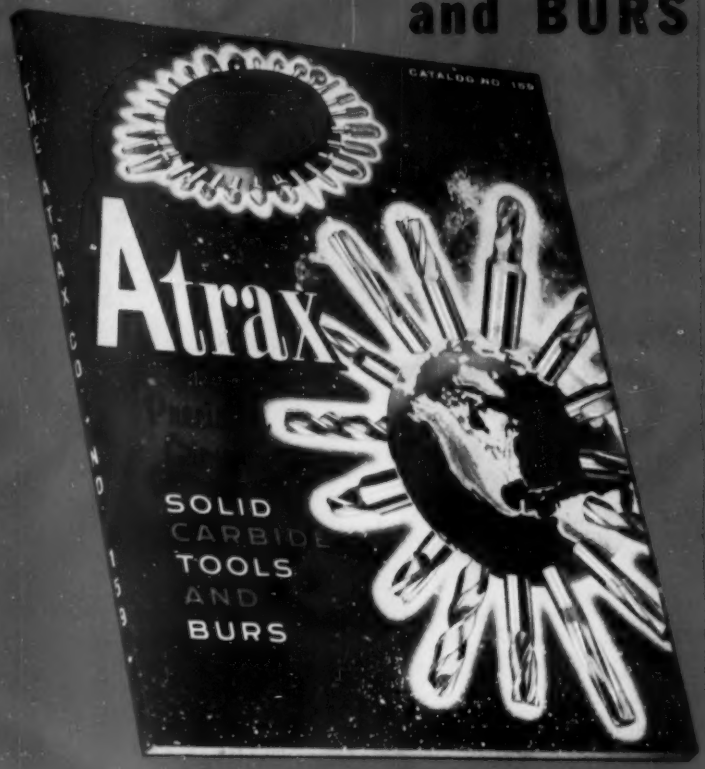

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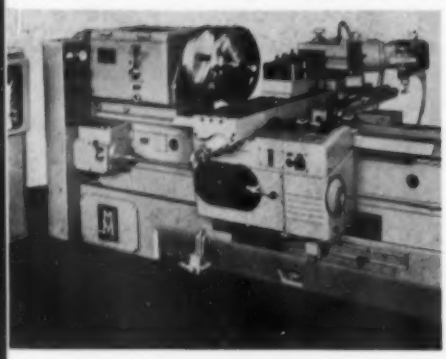


and turret head, as well as operational functions such as spindle speeds, feeds, feed directions and rapid traverse, loading operations, and stopping of the machine.

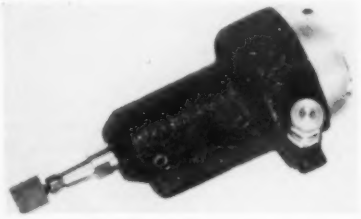
Prime components of the Eltropilot system are a plug panel for accepting and issuing instructions, a prepared punch-card to indicate correct placement of plugs in panel sockets, and interchangeable trip dogs set in cam plates according to desired dimensions.

The Eltropilot can store 60 commands and control 20 operations, with infinite combination of 20 commands for any operation. Setup is simple. For each new component only the punch chart and trip dog positions need be changed. Short and long runs are equally economical. The working cycle can be interrupted at any time and the tools will return automatically to their starting position. Built-in safety devices check all operations closely and any failures are immediately pinpointed by signal lamps.

Cosa Corp., 405 Lexington Ave., New York 17, N. Y. **T-6-18**

Hand Grinder

The air jet hand grinder, with a speed of 75,000 rpm utilizes push-button stop brake for immediate shutoff



and a speed regulator for rotary files and burrs.

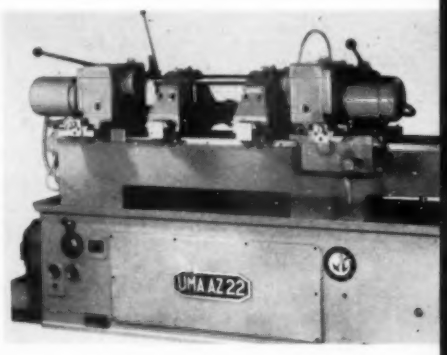
M-F Engineering Co., 13828 S. Western Ave., Blue Island, Ill. **T-6-19**

End Facing And Centering Machine

Model AZ22 end facing and centering machine is manufactured in Western Germany in capacities from 40 to 100 in. between centers. Beyond the initial loading operation it is fully automatic. The piece is inserted, a button is pressed and the automatic cycle begins instantly. A milling cutter brings the piece to uniform length and then the centers are inserted.

Because spindles run counter to each other, right-hand cutters are used on both sides. It utilizes standard high-speed steel cutters.

Milling speed can be preselected and



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Coromant S1P
Increased Carbide
Tool Life
Up To
53%

SANDVIK CORO-MANT S1P Used in FUTURMILL Indexable Cutters Outproduces Other Carbides 1½ to 1 Machining Abrasive Silicon Structural Steel at R.C. Mahon Co., Detroit, Mich.

This is another Coromant case history where Coromant carbide constant quality and competent field engineering combined to deliver cost-cutting results on a tough application.

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89-194

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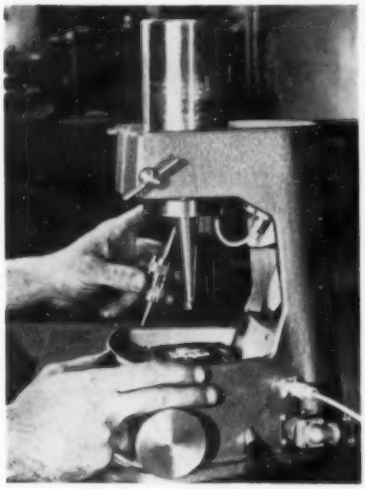
coupled to a suitable speed of the centering drills. The milling spindles have a direct drive by three-speed motors.

Columbia International Corp., 10-35 Forty-fourth Dr., Long Island City 1, N. Y. **T-6-20**

Ultrasonic Impact-Drill

An automatic tuning control system is incorporated in the design of the Glennite ultrasonic impact-drill. As the impedance changes, the tool retunes automatically.

The tool drills, slices, engraves, shapes, taps, broaches, dices, shaves,



trepans and machines. Adaptable for the shaping of intricate parts to precision tolerances, applications include ultrasonic machining of such materials as ceramics, glass, silicon, germanium, tungsten, granite, ferrite, tungsten carbide, quartz, precious stones, aluminum oxide etc.

Gulton Industries, Inc., 212 Durham Ave., Metuchen, N. J. **T-6-21**

Inert-Gas Welding Machine

The TIG model Idealarc welder for either tungsten inert-gas welding, or conventional metallic arc welding is available in the NEMA rated 300-amp size either as a straight a-c transformer welder or as a combination a-c/d-c rectifier welder. The welder has a saturable reactor type control.

Optional features for either type include a high-frequency kit complete with controls for water, gas and high-frequency arc intensity; remote hand or foot control for adjusting amperage to fill craters or compensate for variations in the joint; a d-c filter to eliminate d-c created in the arc when welding with

a-c and high frequency; a line starter with overload protection and either line —or 115-v pushbutton; and power factor correction condensers.

Electrical circuitry and construction is designed to give the arc maximum cleaning effect on aluminum and facilitate faster welding speeds. Current control has three ranges set by a selector switch with continuous rheostat adjustment.

The Lincoln Electric Co., Cleveland 17, Ohio. **T-6-22**

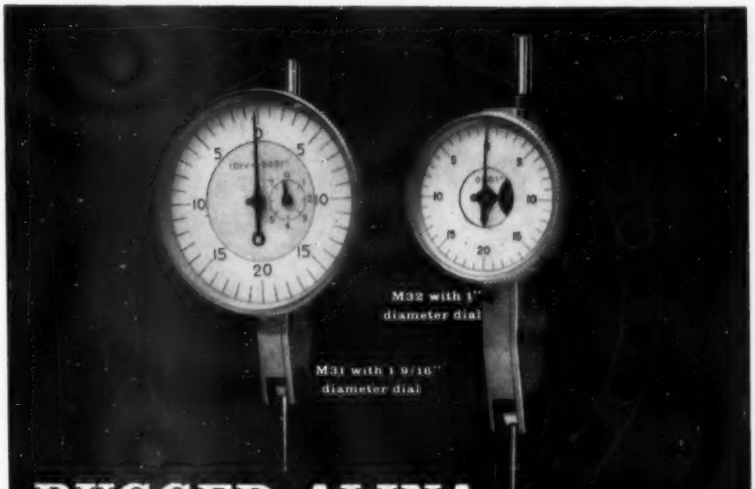
Flame Cutting Machine

Any size intricate metal part can be reproduced with the automatic, unlimited-capacity Oxweld CM-60 shape-cutting machine. It is powered by two electrically coordinated heavy-duty motors providing ample power for every type of flame-cutting operation.

The machine can flame-cut intricate parts of any length, width or thickness. Standard models can be equipped with 10 torches to cut any width up to 10 ft. Larger models cut shapes of any width and can be equipped with additional torches. Thickness of metal that can be cut is limited only by the capacity of the torches used.

A photoelectric tracing system automatically compensates for kerf width; parts can be reproduced from an exact sized drawing without the necessity of making allowance for kerf width on the drawing.

Simple pencil or ink sketches of intricate metal shapes and forms can be used to guide the CM-60. The photocell tracer accurately follows the sketches on ordinary paper, and will accurately follow crossing lines to produce extremely intricate shapes. Neither the machine nor tracer ever come in con-



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And the best part—direct labor costs were reduced 50%; expensive solvents were eliminated; rejects due to contamination were eliminated; and the complete Bendix Sonic Energy Cleaning System was fully amortized in six months.

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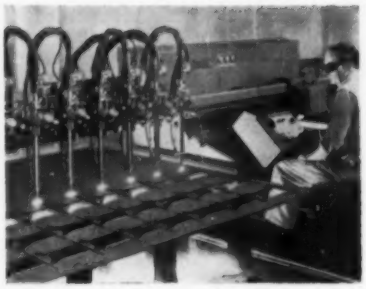
Bendix AVIATION CORPORATION

SONIC ENERGY CLEANING

INDICATE A-6-156



tact with the template or tracing surface.

All cutting operations are immediately controlled by a single operator at a control panel. Tracing, ignition, preheat, cutting oxygen, height adjustment of the torches, movement of the carriages and positioning of the tracer can be handled from the control panel. Individual motors in each cutting torch holder provide independent and accurate vertical control of each torch.

Circular parts can be cut without use of templates with a special circle cutting attachment.

Linde Co., Div. of Union Carbide Corp., 30 E. 42nd St., New York 17, N. Y. **T-6-23**

Circle Cutting Attachment

Precision holes can be cut in thick metal plate with this Or-O-Co circle cutting attachment which can be used with any acetylene cutting torch. By turning a crank, circular holes and solid disks, ½ to more than 12 in. in diameter are cut. Squares, rectangles, and odd

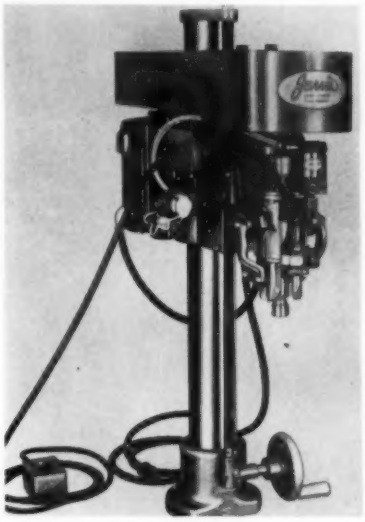
shapes of any size also can be formed accurately. The portable, lightweight tool can be taken to the work. Because of small size, it will operate in confined spaces. A gear mechanism employed in the tool makes cutting smooth and fast without compass-arm guides.

Ideas, Inc., 214 Ivinson Ave., Laramie, Wyo. **T-6-24**

Lead Screw Tappers

Adaptable to any drill press table, this automatic, adjustable pitch lead screw tapper, is furnished in five standard models. Four-speed pulleys give speeds of 575, 958, 1437 and 2415 rpm. Tapping cycle is completely automatic —through air and electrical controls— and can be interconnected with the controls of an indexing table. Tap depth is electrically controlled and can be set to any depth within the stroke of the lead screw unit, which permits rapid conversion from one pitch to another.

The equipment can be equipped with standard hand-operated leadscrew units,



where complete automation is not desirable. SP Models can be supplied with multiple spindle heads for multiple tapping operations.

Capacity of the five Models range from No. 0-No. 12, to No. 10-5/8.

Jarvis Corp., Middletown, Conn. **T-6-25**

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Automatic Screwdriver

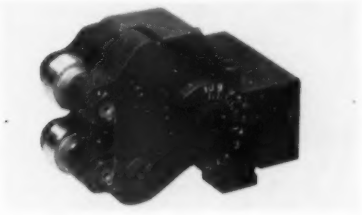
This screwdriver, manufactured by Russell Auto-Feed Screwdrivers, branch of Needle Industries, Ltd., England, is built in various models to automatically feed and drive screws in a multiple of sizes ranging from No. 0-80 to ¼ in. It can be mounted in either a motorized bench-driving stand or a floor model driving stand equipped with the necessary air cylinders and electrical controls for foot pedal operation, so that it can be adapted for driving screws by hand operation, semiautomatically or fully automatically. The small models are sensitive enough to

drive screws into the hinges of eye glasses, and the largest model is capable of driving screws ¼ in. diameter by 2¼ in. long. Special attachments are available to drive screws in hard-to-reach places. Special designs for multispindle screwdriving also are produced—twin or triple driving mechanisms will drive two or more screws at the same time, or can be used as an attachment for numerical types of machines.

H & G Sales Corp., P. O. Box 1589, New Haven 6, Conn. **T-6-26**

Thread Rolling Attachment

Model B5 thread rolling attachment for use on the No. 00 B & S single spindle automatic affords diameter capacity from 0 to 5/16 in. and a maximum thread length of ½ in. The two-roll attachment is adjustable and self-compensating. Free floating movement of the B5 Head in the cross-slide adapter provides parallel alignment of the thread rolls with the center line of the work throughout the entire rolling cycle.



An advance compensator allows rolls of the same diameter to be used interchangeably, while a precision micrometer gage is used in setup for accurate positioning of the attachment in relation to the work.

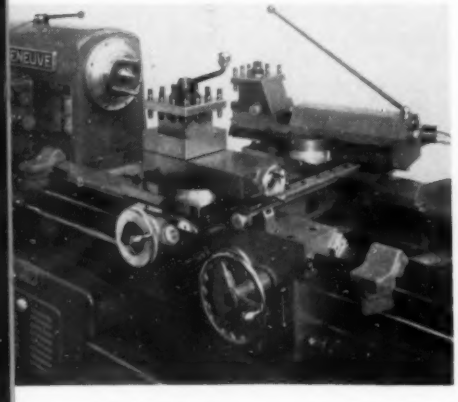
Reed Rolled Thread Die Co., 791 Main St., Holden, Mass. **T-6-27**

Lathes

Contour turning and standard lathe operations can be performed at one setup and frequently accomplished at the same time by these HB Model lathes recently introduced into the United States.

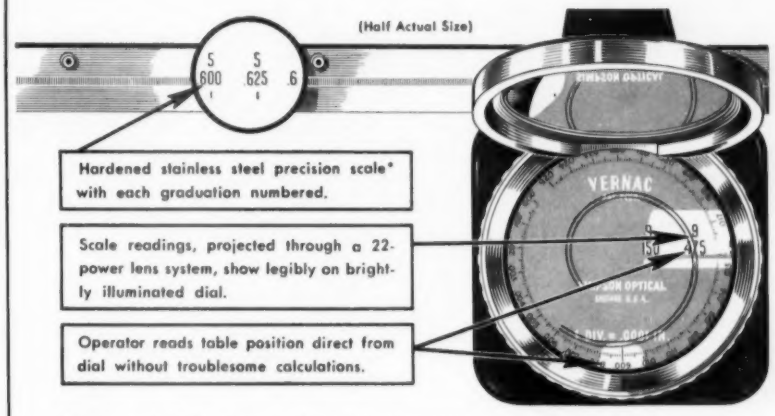
The machine incorporates high horsepower drives, spindle speeds up to 3200 rpm, unitized spindle construction providing spindle accuracies to less than 50 millionths of an inch. The tool post turret construction assures accurate tool positioning to less than 3 microns. Universal copying equipment performs both facing and longitudinal contour operations. Models run from 18 to 36 in. turning diameter capacity, with bed lengths available from 27 in. to 30 ft.

Cazeneuve Sales Co., 755 Pennsylvania Ave., San Francisco 7, Calif. **T-6-28**



Vee Drill

With the Najet No. 7A vee drill, microdrilling is made comparable to normal drilling operation. There is no vibration, drill runout, spindle and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Scale readings, projected through a 22-power lens system, show legibly on brightly illuminated dial.
Operator reads table position direct from dial without troublesome calculations.
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The new VERNAC Direct Reading Optical Measuring Instrument eliminates the complexities of using end rods and gage blocks. Now, the longitudinal, lateral or vertical positioning of machine tool tables can be quickly and easily read direct to .0001". Accuracy is not affected by the wear or stretch of table movement screws. The instrument itself has no moving parts which can impair accuracy.

VERNAC instruments also up-grade machine tools to perform tasks beyond their original accuracy. For example, they can up-grade moderately priced milling machines to the accuracy of more expensive jig boring machines at a fraction of the latter's cost.

*The scale is a replica of a master certified by the U.S. National Bureau of Standards to .0001" maximum error over its entire length.

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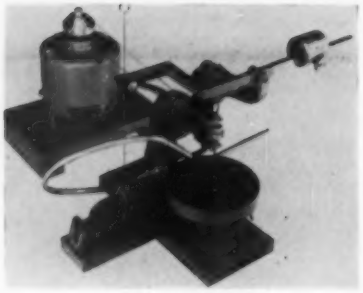


bearing tolerance or lost motion in the leverage system. Designed to permit an inexperienced operator to drill holes from 0.001 to 0.015 in. diameter, the tool is capable of drilling holes in steel as small as 0.00025 in. diameter.

Each drill is its own spindle and rotates in open-jewelled vees. The pivot-mounted leverage system reduces friction and gives magnified control and sensitivity to the operator. Optical equipment provides proportionate stereoscopic visual magnification.

It does not employ a chuck, nor conventional spindles and bearings, but provides the equivalent of absolute zero spindle and bearing tolerance.

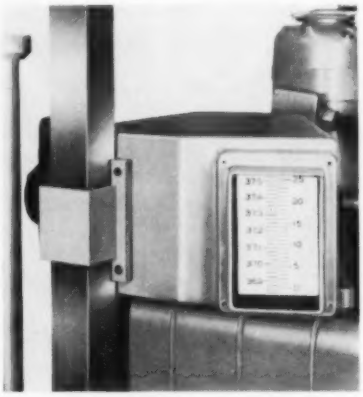
An operating leverage mechanism, eliminates normal nerve tremor of the human finger by giving a leverage ratio reduction of approximately 20 to 1. This mechanism is so counterbalanced that it overcomes the inertia induced by the minute friction of the precision pivoted bearings in this leverage system.

Carl Hirschmann Co. Inc., 30 Park Ave., Manhasset, N. Y. **T-6-29**

Optical Measuring System For Boring Mills

Fast, accurate reading vernier scales for vertical and horizontal movements of a boring mill is accomplished through the Gilbert Tele-Vernier optical projection device.

The image of the stainless steel scale, graduated to 1/40 in., is projected on a ground glass about 3 x 5 in. Vernier



scale on the screen has 25 graduations. About 0.6 in. of scale is projected.

There is no problem of errors caused by the parallax.

The Tele-Vernier is controlled from the pendant station on Cincinnati Gilbert boring mills. Each control includes a pushbutton which illuminates the screen, and starts a timer which automatically turns off the lamp after a given interval. Two buttons adjust the vernier for starting position.

The Cincinnati Gilbert Machine Tool Co., 3366 Beekman St., Cincinnati 23, Ohio. **T-6-30**

Remote Positioner

Remote and automatic high accuracy control for valves, variable displacement pumps, machine tools or adjustable speed drives, is provided by the D-52 Dialtrol remote positioner which incorporates transistorized circuitry and printed circuit techniques. Automatic control may be provided by liquid level, dancer roll, pressure transducer or other signal devices. It is designed for panel mounting or for desk top use. The printed circuit board may be installed in other multipurpose control cabinets or several boards may be installed in a single cabinet for multiunit or programmed control.

Shaft-mounted Shaftrol actuators come in four sizes developing torques from one to several thousand in.-lb. Each size is available at a variety of speeds, with full control rotation from 60 deg to 40 turns. The Dialtrol posi-

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Heavy-duty open-gap production presses with Hannifin hydraulic index tables...

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Full Automatic Cycling
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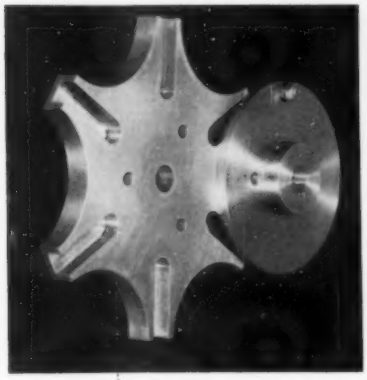
tioner also provides control for linear actuators (Lineatrols) developing thrusts up to several thousand pounds with stroke lengths to 40 in.

The Jordan Co., Inc., 3235 W. Hampton Ave., Milwaukee 9, Wis. **T-6-31**

Drives

The external geneva motion Tangen drives provide a way of converting rotary to intermittent or indexing motion by indexing to speeds up to 2000 indexes per minute. Indexing is smooth



and positive in either direction. Locking after each index is accurate within 0.001 in.

The drives are available in any center distance from 1 to 24 in. and to index to any given number of stations.

Geneva Motions Corp., 1114 N.E. Cleveland St., Clearwater, Fla. **T-6-32**

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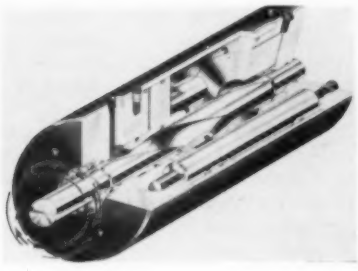
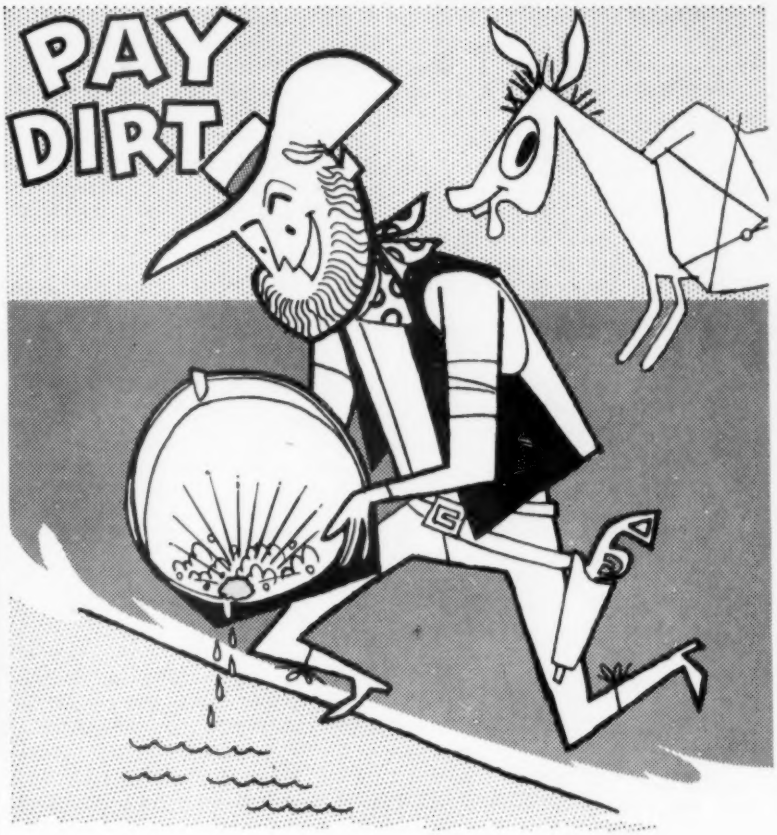
Rotary Torque Actuator

Full cushioning is standard in a rotary torque actuator designed to provide 0 to 370 deg of high-torque rotation. Powered by air, gas, water or oil, the actuator seals dead tight and will not back off under tension, shock, vibration, or complete power failure. It may be stopped at any point in the rotation cycle.

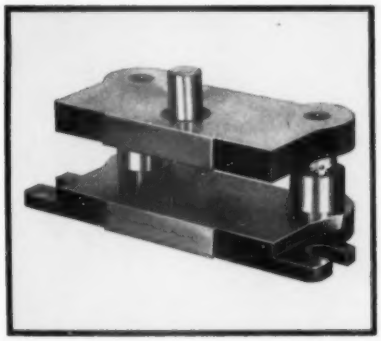
The full cushioning provides smooth, controlled deceleration at the end of





NOW, in addition to all the other advantages of Lempco Ball Bearing Die Sets, we've developed new special alloy ALUMINUM ball bearing retainers. 50% longer life than brass retainers and 50% less weight. The BEST has been made even BETTER! No other die sets known could equal our ball bearing die sets with BRASS retainers, now we've added ALUMINUM for phenomenal long life, millions of strokes, with a very minimum of maintenance and care.

If you're not already using Lempco Ball Bearing Die Sets, better write us today for Catalog and Price Lists.



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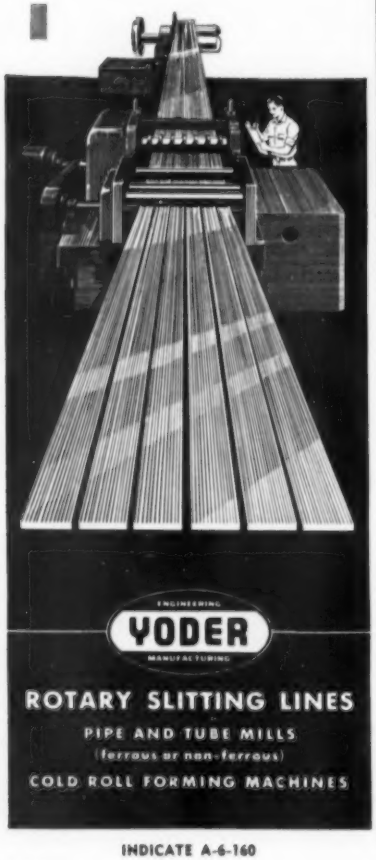
YODER

Rotary Slitters

Product dependability—integrity of manufacture—engineering for specific production needs have all contributed to establish Yoder equipment as the industry standard of excellence. Since 1909 Yoder-built machinery, including Pipe and Tube Mills, Roll Forming Equipment and Rotary Slitters, have earned world-wide customer satisfaction and recognition.

Profit from Yoder's years of engineering and service experience. Send today for the illustrated Yoder Slitter Book.

THE YODER COMPANY
5525 Walworth Ave., Cleveland 2, Ohio



INDICATE A-6-160

either the clockwise or counterclockwise rotation cycle. An extra 5 deg of rotation at the end of either cycle permits use of full quadrants of rotation in all standard rotation cycles. These standard cycles are: 0 to 100 deg (providing a full 90-deg rotation with the 5 deg of overtravel); 0—190 deg (providing a full 180 deg); 0—280 deg (full 270 deg) and 0—370 deg (full 360 deg). Bore sizes available are 4, 5, 6, 8, 10 and 12 in.

Rotary torque output ranges from near 0 to 15,000 in-lb depending on input pressure and bore size of the unit in question.

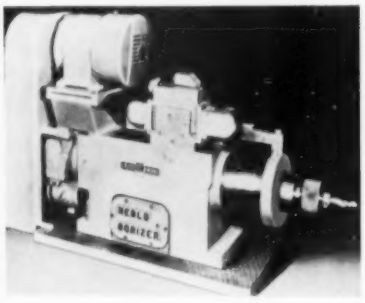
Foot mounting and front or rear flange mountings are available. Special mounting styles are available on order. All parts for Carter rotary torque actuators are completely interchangeable to provide easier factory servicing.

Carter Controls, Inc., 2910 Bernice Rd., Lansing, Ill. **T-6-33**

Boring Head

A self-contained Red Head unit for rotating and feeding single or multiple tools generates its own hydraulic power and can be used singly or in groups for drilling, reaming, counterboring, chamfering, plunge facing, etc.

Designed to provide economical multiple tooling in automated or special setups, it is particularly adaptable to several single or multiple-spindle operations in sequence by mounting several units (horizontal, vertically or at any



other angle) either on a single base or along an automated line.

Electrical controls of this compact tool may be separate or integrated with master controls of an automated line.

The Borizer is readily adjusted for operation. Easily accessible dogs control cylinder stroke, and an adjustable valve gives infinitely adjustable feed within the feed range of each unit. The tool is available in four sizes with strokes of 8, 10, 12 or 15 in. and with thrust for multiple operations ranging from 9800 to 18,900 lb.

The Heald Machine Co., 7 New Bond St., Worcester 6, Mass. **T-6-34**

Copy Nibbling Machine

Blanks or cutouts of any shape are reproduced directly from a master or template by this Trumpf copy nibbling machine. It also will perform shearing, beading, folding, flanging, peening and slotting operations.

The operator does not need to hold the sheet. It is clamped rigidly to roller bearing-guided coordinates which permit it to be moved freely in any horizontal direction by guiding a tracer pin along the contours of the template. Be-

cause the all-side cutting punch is designed to pierce the starting hole, there is no separate punching or drilling of the sheet.

Rectangular cutouts are positioned directly by built-in rulers without a master. Circular cuts from $\frac{3}{8}$ to 24 in. diameter can be produced by clamping the tracer guiding pin into a revolving, adjustable ruler. There is no need for a centering hole.

Trumpf CN copy nibblers are available with throat depths of 41, 49 and 59 in. They have a cutting capacity of up to 9 ga steel material of 70,000 psi tensile strength.

Cosa Corp., 405 Lexington Ave., New York 17, N. Y. **T-6-35**

Safety Clutch

Slippage at any preset torque up to 300 in-lb provides overload protection for this line of clutches. Full drive reoccurs when torque falls below the preset value. The clutches are protected against accidental adjustment to positive drive. Break-away torque settings are easily adjusted with a threaded adjuster secured with a recessed lock screw.

Standard clutches are integral with single or double grooved sheaves for A or B belts. Five pitch diameters range from 6.2 in. (A belt) to 11 in. (B belt). Special clutches may be integral with sprockets, pinions, etc. Units fit on

shafts up to 1 inch in diameter and extend 2¾ inch along the through or stub shaft. Standard sheaves have oil-impregnated bearings with provision for reoiling.

The Edgemont Machine Co., 2200 Home Ave., Dayton 1, Ohio. **T-6-36**

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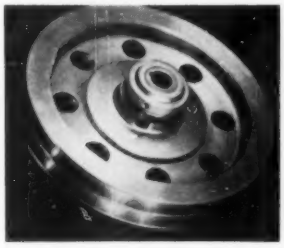
Clamp Fastener

This assembly, which is used as a clamp fastener or structural building unit, consists of a mounting angle and a linking clamp. The clamp is available in four variations: for ½-in. rod or tubing, ¼ or ⅛-in. pipe, and for ⅜-in. armored electrical cable. The angle, provided with tapped holes for mounting micro switches and with mounting



holes for screws, serves both as a "jump off" point and as an end point mounting device.

All five units are equipped with locking teeth that assure a vise like grip when the screw is tightened. Each unit will match with any of the others or with a like unit to give perpendicular or parallel relationships or angular positioning in 10-deg increments. Because of the ability to position angularly, unusual rigidity can be achieved without intermediate devices. The clamps do not raise burs, and repositioning is simple.

Versa-Loc Corp., Southern Blvd., Chatham, N. J. **T-6-37**

For almost every hardness testing requirement

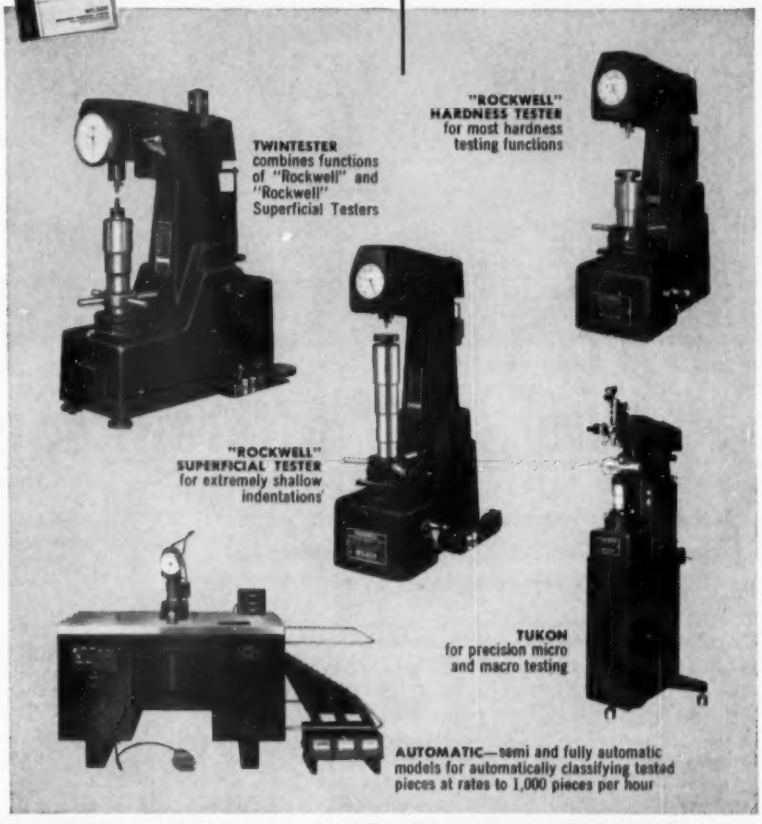
There's a Wilson "Rockwell" instrument to do the job

Wilson "Rockwell" Hardness Testers can help make your products better, stronger, longer lasting. They give reliable results on the production line, in laboratories, in tool rooms, and in inspection departments. They're as easy to use as a center punch, as durable as a machine tool, as sensitive and accurate as a precision balance. That's why Wilson "Rockwell" is recognized as the world's standard of hardness testing accuracy.

Wilson "Brale" Diamond Penetrators give Perfect Readings

A perfect diamond penetrator is essential to accurate testing. Only flawless diamonds are used with Wilson "Brale" penetrators. Each diamond is cut to an exact shape. Microscopic inspection and a comparator check of each diamond—one by one—assure you of accurate hardness testing every time.

Write for Catalog RT-58. It gives complete details on the full line of Wilson hardness testing equipment.


TWINTESTER
combines functions of "Rockwell" and "Rockwell" Superficial Testers
"ROCKWELL" HARDNESS TESTER
for most hardness testing functions
"ROCKWELL" SUPERFICIAL TESTER
for extremely shallow indentations
TUKON
for precision micro and macro testing
AUTOMATIC—semi and fully automatic models for automatically classifying tested pieces at rates to 1,000 pieces per hour

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ACCO

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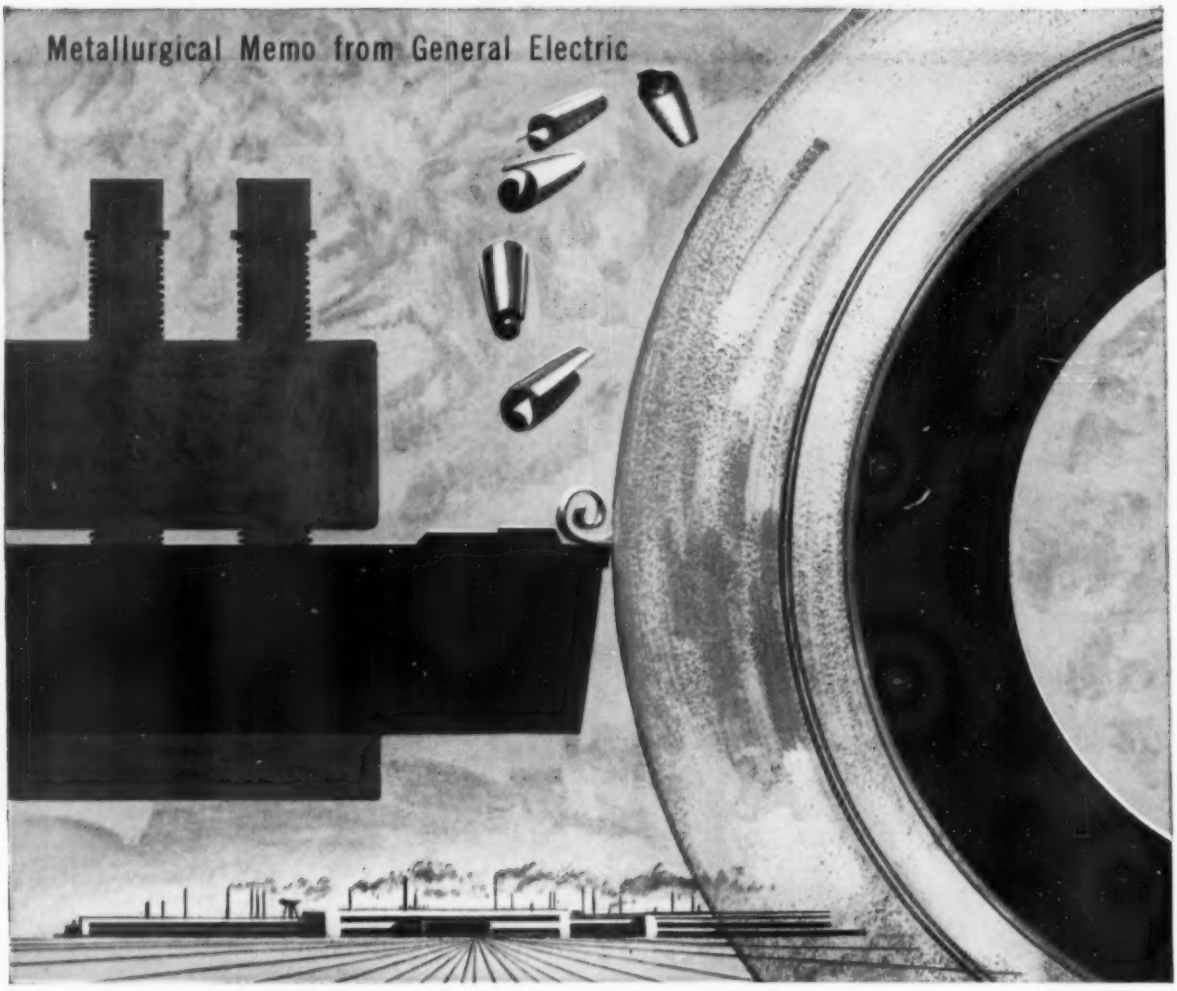


Why 242 different toolholders?

Metallurgical Products Department reports on an expanded new line of Lift-O-Matic toolholders . . . 242 sizes to speed changeovers on every job

Nobody needs to tell you what carbides have done for metalcutting . . . or how Carboloy® disposable inserts have led the way. *But making inserts is only half the job;* the other half is to provide you with toolholders that let you get full value from these miracle metals.

Carboloy Lift-O-Matic toolholders do this job. There are now three types—positive rake, negative rake, and tracer. All provide access to the clamp setscrew from either top or bottom—together with a self-raising chip-breaker clamp—for fastest possible indexing. All cut your inventory needs by providing interchangeability of parts. In addition, there is a full line of Carboloy *heavy-duty* toolholders.

This expanded Lift-O-Matic toolholder line is stocked by your *local* Authorized Carboloy Distributor—3 types, 9 styles, 242 sizes—*plus* the widest range of styles, sizes, and grades of *inserts* in the industry. Call him (see the Yellow Pages under "Carbides"); or write: *Metallurgical Products Department of General Electric Company, 11101 E. 8 Mile Ave., Detroit 32, Michigan.*

CARBOLOY
CEMENTED CARBIDES

METALLURGICAL PRODUCTS DEPARTMENT

GENERAL ELECTRIC

CARBOLOY® CEMENTED CARBIDES • MAN-MADE DIAMONDS • MAGNETIC MATERIALS • THERMISTORS • THYRITE® • VACUUM-MELTED ALLOYS

Men at Work

Robert M. Miller (left) has been promoted by Onsrud Machine Works, Inc. to vice-president and general sales manager in charge of marketing and direction of sales for all company divisions.

Vernon L. Loofboro (right) was appointed executive vice-president of Gardner Machine Co. He previously served as general manager.

Four executive positions have been filled for Parker-Kalon Div. of General American Transportation Corp. LOUIS LOVISEK, chief engineer, was named manufacturing manager; HAROLD ROSENBERG became plant manager, ED HOLMES was promoted to planning manager, and HERB RODAMAN was made assistant general manager. All four men are veterans of more than 20 years with Parker-Kalon.

The board of directors of Maurey Mfg. Corp. recently made RUSSELL B. MALLOY vice-president in charge of sales and JOSEPH F. TAYLOR assistant vice-president. Mr. Malloy formerly was sales manager for all Maurey divisions while Mr. Taylor has been with Goodyear Tire and Rubber Co. for the past 18 years.

The Metal Powder Industries Federation re-elected GEORGE A. ROBERTS president for the next term of office. Dr. Roberts, a member of ASTE's Pittsburgh chapter, is vice-president-technology of Vanadium-Alloys Steel Co.

George H. Fromer has been named president and general manager of Atlas Drop Forge Co., wholly-owned subsidiary of Dana Corp. Prior to joining Atlas, he was general manager of Taylor Forge and Pipe Works.

Gisholt Machine Co. recently announced that **Fred L. Chapman** had retired after 30 years of service. He had been vice-president in charge of sales and a member of the Company's board of directors since 1955.

ERIC G. MESSLER was elected vice-president and assistant general manager of Sandvik Steel, Inc. He has been associated with Sandvik since 1955 in the dual capacity of manager of Coromant carbide sales and manager of steel sales. The former post now has been filled with the appointment of DAVID P. CAMERON, who has been with the Coromant sales department since June 1958. Mr. Messler belongs to ASTE's Paterson chapter, and Mr. Cameron to the Boston chapter.

Clearing Div. of U. S. Industries, Inc. has appointed ASA SNYDER director of research and development. He joins Clearing following considerable experience in research management with various industrial concerns.

E. P. BULLARD III, president of The Bullard Co. recently assumed the duties of chief executive officer relinquished by E. C. Bullard, chairman of the board, a post in which he will continue to serve.

According to recent announcement, L. R. JEFFREY, JR. was elected president and general manager of National Ultrasonic Corp. He previously served as vice-president of Alcar Instruments, Inc.

At the stockholders' meeting of Eastern Machine Screw Corp., CHARLES W. WESSON was elected president of the corporation to succeed CARL W. BETTCHER who became chairman of the board.

ANDREW H. LEINGANG has been elected vice-president, charge of manufacturing and director of sales for The East Dayton Tool & Die Co. Mr. Leingang, who joined the firm in 1933, has been sales manager.

Announcement from Warner Electric Brake & Clutch Co. made public the appointment of ROBERT A. HEATH as manager of engineering, responsible for all operating divisions and functions. Prior to this he was chief engineer for the Walker Mfg. Co.

John J. Hayes is now president of the Morse Twist Drill & Machine Co., division of Van Norman Industries, Inc. He formerly served as executive vice-president and general manager of the division.

James A. Taylor is new president of Standard Screw Co. to succeed W. D. Corlett who became board chairman. As president of Hartford Machine Screw Co., Mr. Taylor continues to direct that division.

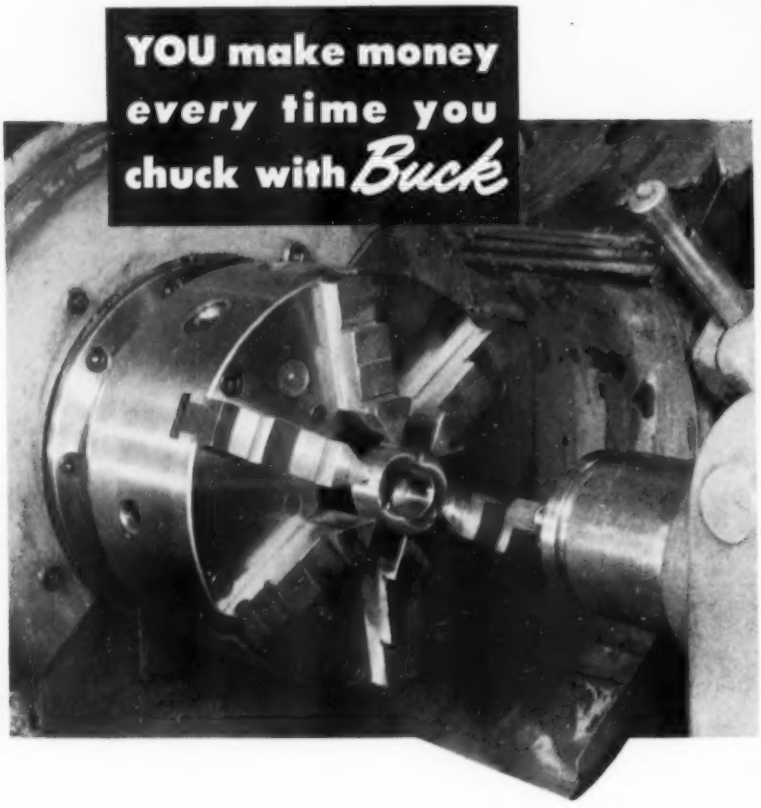
elected a vice-president John L. Molner was of National Acme Co. to succeed A. E. Drissner who retired. Mr. Molner, who has been with the company for the past 42 years, was formerly its chief engineer.

E. D. WHITE was named vice-president and general manager of Union Die Casting Co. Associated with the die casting field for 14 years, he has been with Union Die Casting since 1954.

Harold F. Schulte recently was named chief engineer of Wheelabrator Corp. Associated with the company since 1940, he has held various important positions in sales, service and engineering departments and has been acting chief engineer for the past year.

Paul A. Mongerson (left) was promoted to vice-president of The Chicago Screw Co., division of Standard Screw Co. He formerly was factory manager, a post now filled by W. Dean Gwin.

Ralph E. Price (right) was elected executive vice-president and assistant general manager of Landis Tool Co. He formerly was vice-president of Landis.



1. You get *dead true* precision chucking single parts—.0005" precision on duplicate parts. (Conventional chucks are only accurate to .003" *when new.*)

2. You save costly machinists' time. Takes but a minute to indicate and adjust a Buck. No fooling around with shims.

3. The Buck Ajust-Tru® principle helps compensate for spindle run-out, compensates for chuck wear—greatly lengthens chuck life.

Buck Ajust-Tru 3- and 6-jaw chucks cost no more than conventional chucks. Send for catalog—see for yourself why "It pays to chuck with Buck."

Makers of Scroll, Power, Dust Proof, Independent Chucks.

BUCK TOOL COMPANY

633 SCHIPPERS LANE • KALAMAZOO, MICH.

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The board of directors of Westinghouse Electric Corp. elected MARK W. CREAP, JR. president and chief executive officer and GWILYM A. PRICE board chairman. Election followed the announcement that Mr. Price had been named president of the board of trustees of the University of Pittsburgh.

At its annual meeting, the American Welding Society elected CHARLES I. MACGUFFIE, manager of special products department, Air Reduction Sales Co., president of the organization for the coming year.

To serve with him, the society elected R. D. THOMAS, JR., president of the Arcos Corp., as first vice-president; and A. F. CHOUINARD, director of research development at National Cylinder Gas Co. as vice-president.

Size Control Co., division of American Gage & Machine Co. has named FRANK J. VLASATY to fill the recently created post of director of research engineering. A former chief inspector with Size Control Co., he has spent the past 10 years at Ford Aircraft where he was in charge of quality control engineering.

At Warner & Swasey Co. LESTER M. COLE was made vice-president in charge of sales. A member of ASTE's Cleveland chapter, he has been general sales manager of the company. He will direct sales activities of the Machine Tool Div. and two other divisions.

RUSSELL G. HEYL, JR. was named chief engineer-research and development for American Metal Products Co. He has been associated with AMP since 1950 and its chief product engineer since 1956.

Election of officers for the Metal Powder Producers Assn. resulted in naming of CHARLES E. HANSON as president for 1959-60 to succeed ERNEST H. KLEIN of The New Jersey Zinc Co. Mr. Hanson is associated with Plastic Metals, division of National-U.S. Radiator Corp. MPPA is a trade division of Metal Powder Industries Federation.

SCRAPPED . . .
BY INCHWORM!

The INCHWORM™ Motor brings an entirely new concept of precision and closer tolerances to the machine tool industry.

Many leading producers of precision machined parts have replaced centerless grinder lead screws with INCHWORMS to achieve:

- **tolerances to ± .000025"**
- **elimination of *backlash***
- **lower production costs**

The INCHWORM Motor works on the principle of magnetostriction, enabling the machine tool operator to advance or retract the tool in microscopic increments by simply pushing a button. An easily read dial gives him control, with 50 times the accuracy possible with a conventional lead screw. And, he doesn't have to take time to retract the lead screw and slowly advance it again—he gets final size simply by pushing the button.

AT NO EXPENSE TO YOU . . .

The INCHWORM Motor can be installed on your centerless grinder in less than an hour —and prove itself almost immediately. We will install it in your plant, *on approval*, upon the recommendation of our sales engineer.

Send for the complete story!

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HUNTINGTON STATION, L. I., N. Y.
A DIVISION OF CUTLER-HAMMER, INC.

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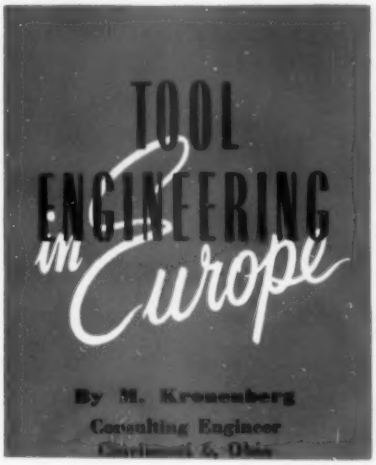

Machining With Ceramics

A survey of the methods used in machining with ceramic tools is given in the Swiss periodical *Technica*, Vol. 8, (1), 1959, p. 5-10. The article is published anonymously under the title: "Zerspanung mittels oxyd Keramischer Schneidstoffe."

The chemical and physical properties of ceramic tool materials are discussed and also the manufacturing processes for these materials. Great importance is laid on correct tool geometry and rules are given for turning operations with ceramic inserts. The wear pattern is compared with that for carbide tools. Grinding of chip breakers and cutting edges is described in detail with examples. The last section is devoted to the application of ceramics in milling operations.

Machining Versus Forming

Savings in material are the prime consideration for a comparison of the economy of machining and metal-forming methods according to article published by K. Sieber in *Werkstatts Technik*, No. 1, 1959, p. 13-16, under the title "Wirtschaftlichkeit and Grenzen der Verschiedenen Umform Verfahren."

In cases where the savings in material are equal (percentage wise), the limit number of workpieces is smaller the heavier the weight per piece. The economic comparison is also affected by the machining operations often required after forming.

Low-Load Hardness Tester

Vickers, Knoop and scratch hardness measurements can be taken on delicate small parts with a hardness tester described in *Industrie Anzeiger*, Vol. 84, (4), 1959, P.18-19 under the title: "Klein Haerte Pruefer."

The diamond indentation is invisible to the naked eye due to the low load

Plastic Steel® saved $180

Within a matter of 2 hours this holding fixture was poured and ready for use at General Electric, and the cost — about $20.00 instead of the original $200.00. Whether you need jigs, fixtures, metal forming dies, molds, models, foundry patterns and core boxes or other special tools, PLASTIC STEEL® and other Devcon products will produce a precision form and save hundreds of dollars and hours.

Hundreds of companies have found money-saving advantages by using PLASTIC STEEL for tooling *and* maintenance. It can be used for repairing worn machine parts, cracked castings, leaking hydraulic systems and tanks, rebuilding worn pumps or valves, etc. — make 1001 on-the-spot repairs.

PLASTIC STEEL® — as easy to use as modeling clay — hardens to steel-like strength in 2 hours . . . can be machined with regular tools . . . bonds all metals, wood, glass, concrete, etc., to itself or each other. It has extremely high tensile, compression and impact strength — excellent chemical resistance.

Find out how PLASTIC STEEL.. and other Devcon products can save time, speed production and cut maintenance costs in your plant — write for FREE bulletin today.

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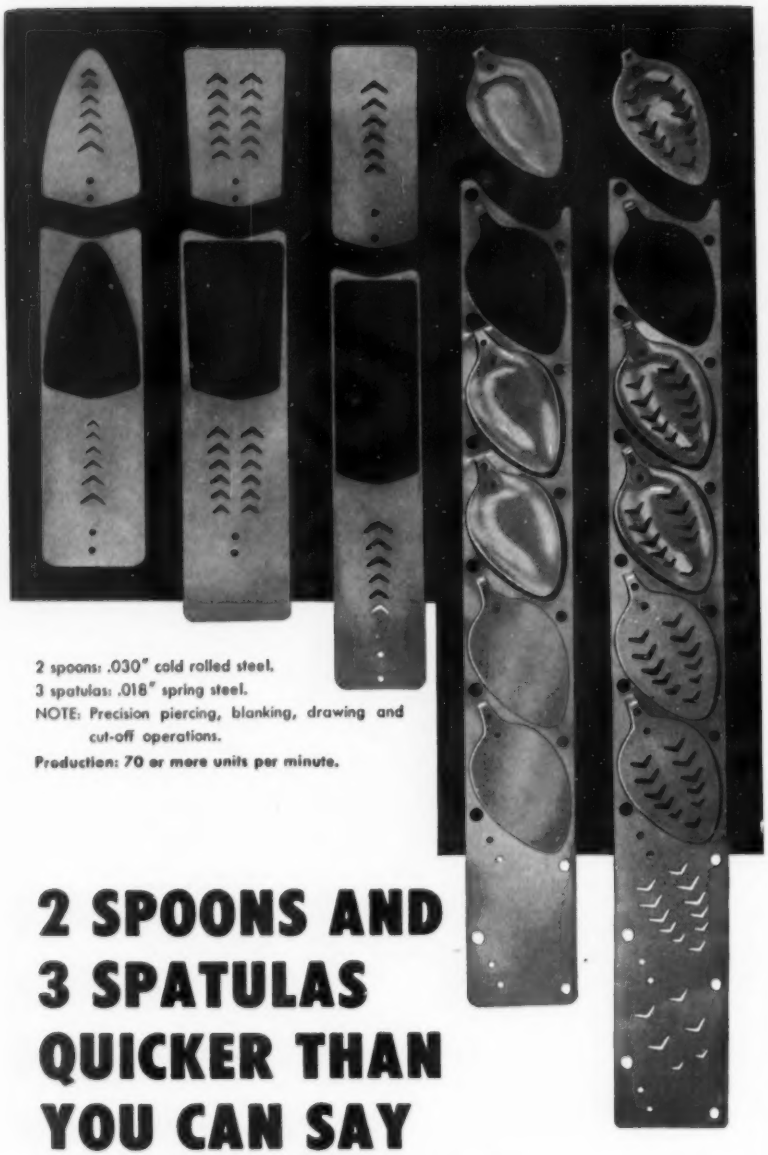

2 spoons: .030" cold rolled steel.
3 spatulas: .018" spring steel.
NOTE: Precision piercing, blanking, drawing and cut-off operations.
Production: 70 or more units per minute.

2 SPOONS AND 3 SPATULAS QUICKER THAN YOU CAN SAY "FLAPJACK!"

Precision mass production of mixing spoons and spatulas—modern designs for modern homemakers—products of B. Jahn "Production Proved" Progressive Dies.

One of America's foremost kitchen tool manufacturers entrusted these five dies to B. Jahn because "nothing is too good for their customers." The result, dependable trouble-free tooling, a superior product, exceptional production speed and economy.

If your product is mass produced...

If "nothing is too good for your customers"...

If dependable production and competitive economy is desirable...

B. Jahn is your source for production speed, economy and tooling ingenuity.

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Send for colorful "Case History" Brochure

THE B. JAHN MANUFACTURING COMPANY, NEW BRITAIN, CONNECTICUT

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that is applied. It is claimed that high accuracy can be obtained using a microscope to test the hardness of cutting edges, precision parts, thin sheets of metal, etc. The diamond is protected against chipping and other mechanical damage. The load is as low as 15 grams (approximately ½ oz) but can be raised to a maximum of 2000 grams (approximately 4.4 lb). The absolute accuracy of measurement is 0.5 microns (0.0002 inch) and the relative accuracy is 0.2 microns (0.000080 inch). The largest workpiece that can be tested is 150 mm (6 inches). The column can be swivelled to permit testing at various angles.

Thin Metal Sections

An "ultramicrotone" has been developed that permits the effects of cutting action on the structure of metal to be observed. The instrument is discussed by L. Reimer in *Zeitschrift fuer Metallkunde*, Vol. 50, (1), 1959, p. 37-41.

The cutter is made of diamond and does not need regrinding for a long time. Thin slices of germanium metal have been made with a thickness of 100 to 300 Angstrom units (0.0000004 to 0.0000012 inch). The thin slices can be penetrated by electrons.

Best cutting results were obtained with a cutting edge of 0.1 to 0.01 mm length (approximately 0.004 to 0.0004 inch). The cutting could be observed through a strong microscope. Eight different metal samples were investigated, using chemically pure metals only in order to find the influence of the cutting operation on the microstructure of the metal. Structures appearing on a network by Bragg reflection are discussed.

Standard Machine Units

German standards for the design of complete machine tool units are discussed in an article by J. Wollenhaupt, published in *Werkstatts Technik*, Vol. 49, No. 3, 1959, p. 132-136, under the title: "Die Konstruktion der Baueinheiten fuer Werkzeug-Maschinen nach VDI 3270 to 3275."

Standard VDI 3270, approved in December 1958, deals with the units for transfer machines with regard to width of the bed, height, length, center portions, carriages for the boring head (including motor) space for workpiece carrier and numerous other details. In this way it is possible to assemble or disassemble machine tools for mass production and to purchase prefabricated additional sections, beds, etc., that fit existing machines.

Six different types of boring heads were standardized. They are driven by flange motor and clutch, flange motor

and spur gears, foot motor and clutch, or other combinations. Center distances for holes are included in these standards and are discussed in detail as are many other items.

Cutting Force Dynamometer

Cutting force dynamometers were first developed in 1905 and have gradually been improved from mechanical and hydraulical methods to systems employing the SR4 strain gage.

A combination of a mechanical and a strain-gage method developed by M. Ehrenreich is described in *Microtecnic*, Vol. 12. No. 6, under the title: "Drehkraft Messer mit Dehnungs Mess Streifen." The instrument permits measuring the three cutting force components (tangential, radial and longitudinal) without mutual interference. Two membranes support the tool for measuring the radial component. The membranes transmit the force to a cantilever carrying a strain gage. The tangential component causes a rotation about a horizontal axis, also resisted by a cantilever spring carrying a strain gage. The same principle is also used for measuring axial force. Output from the three strain gages is measured by means of an oscillograph. Each strain gage constitutes an arm of a wheatstone bridge. An instrument of this type is used at the University of Haifa.

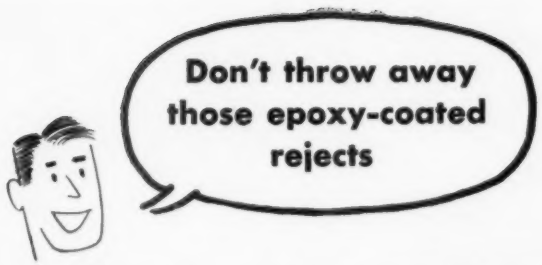
Measuring Frictional Moments

An instrument for determining small frictional moments is described by A. Kuhlenkamp and J. Staroste in *Feinwerk Technik*, Vol. 62, No. 2, p. 47-50, under the title "Messgeraete zur Bestimmung von Reibungsmomenten."

The measuring device is designed for moments as small as one milligram-centimeter (1.4 millionth of an in-oz) and is a development of the Vierweg-Gottwald electrinic equipment company. A spring is used in the instrument, which was developed by Jaguerod for measuring small frictional moments in the range from 0.1 to 2.0 gram-centimeters (0.0014 to 0.0280 in-oz)

Tests proved that an oversupply of lubricants increase the frictional resistance in bearings, a well-known fact which is of significance in the running of machine tools. They run too hot—and accuracy suffers—when the lubricant supply is such as to produce a churning action within the bearings.

The Timken Roller Bearing Co. has offered to purchase the ordinary shares of British Timken Ltd. owned by minority holders. The American company currently owns 2,662,500 shares of the outstanding 5,000,000 ordinary shares of the British company.



Here's a new paint stripper that will save them

Do you scrap perfect metal parts that have been imperfectly coated with epoxies, vinyls, polyesters and other hard-to-strip paints or lacquers?

In the last few months, users of Oakite Stripper S-A have eliminated many such losses. Here's what some of them say about it:

CALIFORNIA: An aircraft manufacturer tested many strippers on an epoxy designed to resist attack by hydraulic fluid. Finally found that Oakite Stripper S-A is "the only one that safely strips this paint from anodized aluminum."

NEW YORK: A camera maker coats flash bulb reflectors with black vinyl paint outside and aluminum paint inside. "Stripper S-A is the fastest ever used on our rejects."

OHIO: A maker of toy pistols had trouble stripping alternate coats of lacquer and metallized aluminum. Now "Stripper S-A does it amazingly fast and remetallizing is completely satisfactory."

CALIFORNIA: A producer of metal furniture uses Stripper S-A to remove clear epoxy from plated parts. Chemist says "This is the best stripper on the market."

ALABAMA: A hardware maker had trouble stripping lacquer from brass door knobs. Oakite Stripper S-A now does the work in "less than ⅓ the time taken by any other stripper."

NEW YORK: A manufacturer of business machines tested several strippers on various finishes on steel and aluminum. Verdict in favor of Stripper S-A was: "It's doing a wonderful job."

CONNECTICUT: A maker of brass lipstick shells has found that "Stripper S-A quickly strips epoxy lacquers from rejects and heavily coated work spindles."

CALIFORNIA: A missile maker reports that "Stripper S-A is doing a fine job stripping vinyl from stainless steel and titanium."

FREE Write Oakite Products, Inc., 58 Rector St., New York 6, N. Y., for complete information on Oakite Stripper S-A.

Technical Service Representatives in Principal Cities of U. S. and Canada

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In our 50th year

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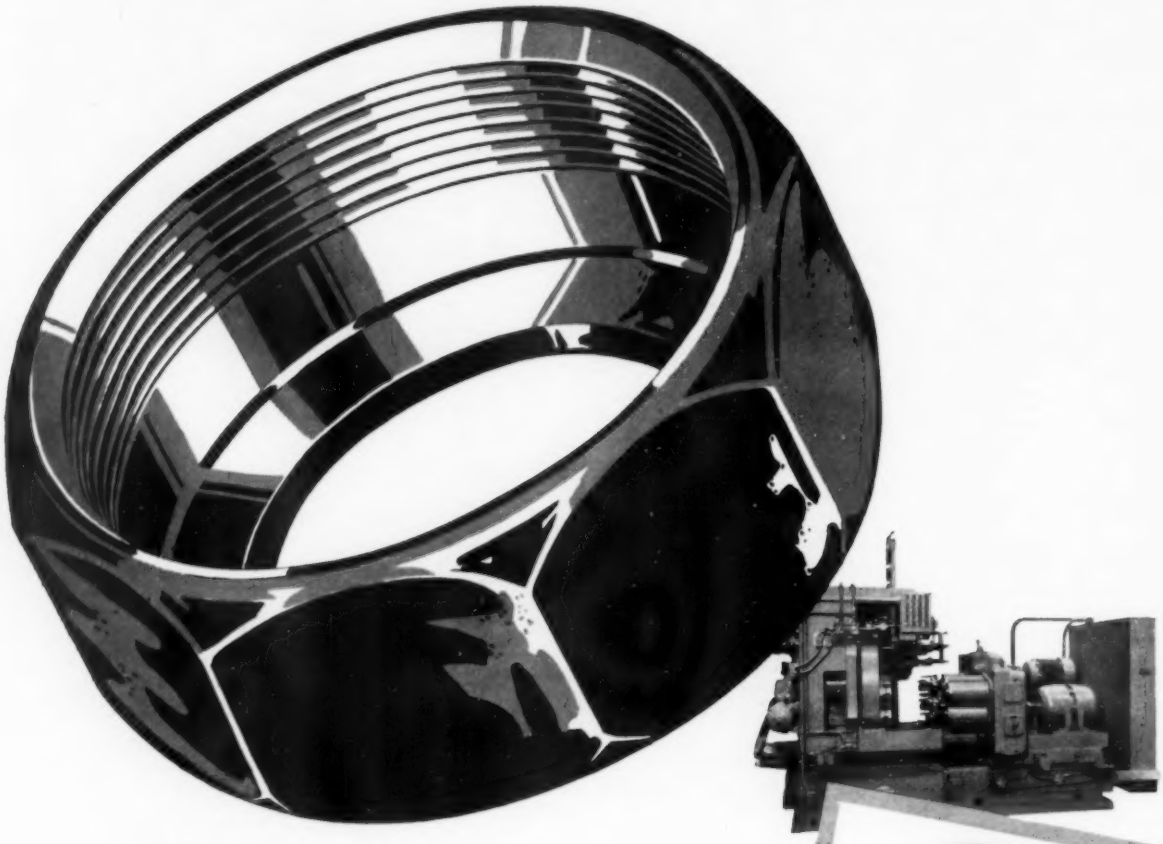
...an example of Automatic Production by Greenlee...



700 malleable iron pipe fittings an hour...

The Greenlee 5 station, horizontal, automatic indexing machine shown above was designed and built for high-production machining of malleable iron pipe fittings. The pipe fittings are loaded, four at a time, indexed and machined at the rate of 576 to 712 pieces an hour, depending on size. The machine accommodates five different sizes of fittings.

STATION 1 — automatic load
STATION 2 — bore and rough counter-bore
STATION 3 — finish counter-bore and chamfer
STATION 4 — tap
STATION 5 — automatic unload

Let a Greenlee representative show you the modern Greenlee approach to automatic production.

MACHINES DESIGNED . . .
WITH THE FUTURE IN MIND

GREENLEE

TRANSFER MACHINES

GREENLEE STANDARD AND SPECIAL MACHINE TOOLS

- Multiple-Spindle Drilling and Tapping Machines
- Six and Four-Spindle Automatic Bar Machines
- Hydro-Borer Precision Boring Units
- Die Casting Machines
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THE TOOL ENGINEER'S *Service Bureau*

TRADE LITERATURE CURRENTLY OFFERED BY THE TOOL ENGINEER ADVERTISERS

A-6-182—Carbide Tools—*Carmet Cemented Carbide Div. of Allegheny Ludlum Steel Corp.* Thirty-two page catalog C-16 "Carmet Cemented Carbides for Industry" contains prices and complete specifications on carbide tools. (Page 182)

A-6-6—Lathe—*The American Tool Works Co.* Bulletin No. 130 contains complete information on Americam Pacemaster lathes for cutting titanium. (Page 6)

A-6-177—Band Saw—*Armstrong-Blum Mfg. Co.* Complete information available on Marvel No. 4 band saw and Marvel metalcutting saws. (Page 177)

A-6-235—Abrasive Cloth—*Behr-Manning Co.* Information on uses of abrasive cloth in new "Metalite" booklet. (Page 235)

A-6-44—Surface Finish Indicator—*Brush Instrument Div. of Clevite Corp.* Booklet "Control the Finish and You Control the Costs" describes Brush Surfindicator and its uses. (Page 44)

A-6-178-1—Vises—*Cardinal Machine Co.* New catalog describes complete line of Cardinal speed vise. (Page 178)

A-6-234-2—Jig and Fixture Components—*Carr Lane Mfg. Co.* Catalog contains data on thousands of stock items for jigs and fixtures. (Page 234)

A-6-67—Broaches—*Chicago Pneumatic Tool Co.* Bulletin 581-2 contains information on broaching holes with a portable broach. (Pages 66-67)

A-6-216-3—Indicator Gage—*Comtor Co.* Bulletin 50 contains data on the Comtor plug gage for hole measure. (Page 216)

A-6-242—Lapping Machines—*Crane Packing Co.* Bulletins describe the Lapmaster line and charts for measuring flatness. (Page 242)

A-6-197—Chucks—*The Cushman Chuck Co.* Cushman air operated chucks described in bulletin PO-48D. (Page 197)

A-6-240-2—Die Cushions—*Dayton-Rogers Mfg. Co.* Complete information on die cushions for all punch presses contained in catalog P-44-A. (Page 240)

A-6-144—Air Gages—*Dearborn Gage Co.* New catalog contains complete price information on Dearborn air instruments and air gage cartridges. (Page 144)

A-6-62—Toggle Clamps—*Detroit Stamping Co.* Clamp applications, scale drawings and complete information on clamps available in new catalog. (Page 62)

A-6-37—Tool Grinder—*DeVlieg Machine Co.* Complete specifications on the Micropoint tool grinder available in new catalog. (Pages 35-37)

A-6-47—Magnesium Tooling Plate—*The Dow Chemical Co.* Fifty-six page book contains facts about shop working characteristics, machining and other engineering data on magnesium tooling plate. (Pages 46-47)

A-6-241—Drilling and Tapping Machines—*Edlund Machinery Co.* Free descriptive bulletins contain data on complete line of tapping and drilling machines. (Page 241)

A-6-234-4—Carbide Cutting Tools—*Esterz Rotary File & Tool Corp.* Catalog 5-A contains complete data on stock tools and information on specials for all operations. (Page 234)

A-6-188—Presses—*Famco Machine Co.* Famco air press brochure contains data on complete line of air presses. (Page 188)

A-6-178-2—Microscope—*The Gaertner Scientific Corp.* Bulletin 147-56 contains complete information on the Gaertner tool makers microscope. (Page 178)

A-6-27—Tracer Lathe—*Gisholt Machine Co.* New Gisholt Jetracer catalog contains information on tracer applications. (Page 27)

A-6-26—Milling Cutters—*Ingersoll Milling Machine Co. Cutter Div.* Booklet No. 68 contains data on how to reduce cost of chips and improve milling and boring performance. (Page 26)

A-6-166—Progressive Dies—*The B. John Mfg. Co.* Colorful "case history" brochure contains information on successful progressive die applications. (Page 166)

A-6-194-2—Tachometer—*Jones Motrola Corp.* Catalog 147-D contains data on the Jones No. 2300 hand tachometer. (Page 194)

A-6-51—Die Steel—*Latrobe Steel Co.* Engineering specifications on desegatized high alloy die steel available in data sheet Olympic F2d. (Page 51)

A-6-224-1—Induction Heating—*Lepel High Frequency Laboratories, Inc.* New catalog has 36 illustrated pages of valuable information on induction heating. (Page 224)

A-6-189—Die Sets—*Lempco Industrial, Inc.* Catalog and price lists available on Lempco ball bearing die sets. (Page 189)

A-6-179—Milling Cutters—*Lovejoy Tool Co., Inc.* Catalogs available on face milling, side milling tools, arbor catalog and speed and feed calculator(Page 179)

A-6-199—Gun Drilling—*Madison Industries, Inc.* Fact file on gun drilling contains tips and techniques on how to save money and increase production. (Page 199)

A-6-209-1—Drill Bushings—*W. F. Meyers Co., Inc.* Bushing catalog No. 43 contains data on carbide insert drill bushings. (Page 209)

A-6-200-1—Hydraulic Clamps—*Newton Hydraulic Tooling Co.* More information available on the Newton hydraulic clamping system in new catalog plus full scale templates. (Page 200)

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TRADE LITERATURE CURRENTLY OFFERED BY THE TOOL ENGINEER ADVERTISERS

A-6-187—**Four-Slide Machines**—*The A. H. Nilson Machine Co.* Nilson general catalog on automatic 4-slide equipment contains complete data and typical applications. (Page 187)

A-6-53—**Milling Cutter**—*The OK Tool Co., Inc.* Free catalogs available on single point tools, milling cutters and solid cutters. (Page 53)

A-6-167—**Cleaning Compounds**—*Oakite Products, Inc.* Complete information on Oakite stripper 5A available. (Page 167)

A-6-70—**Induction Heating**—*The Ohio Crankshaft Co.* Copies of "Typical results of Tocco Induction Hardening, Heat Treating and Annealing" now available. (Page 70)

A-6-151—**Cylinders**—*Ortman-Miller Machine Co.* Bulletin 112 features O-M adjustable stroke air and hydraulic cylinder information. (Page 151)

A-6-180-1—**Dial Indicators**—*Pels-Emery Inc.* Catalog D-D has complete data on the "Em-ro" dial indicators. (Page 180)

A-6-62—**Bending Machines**—*Pines Engineering Co., Inc.* Free case study reports on cold forming available on request. (Page 62)

A-6-156—**Sonic Cleaning**—*Pioneer-Central Div., Bendix Aviation Corp.* Authorative report on sonic energy cleaning contains five step plan to help determine if it will be economically advantageous. (Page 156)

A-6-214-1—**Multiple Spindle Drilling and Tapping Machine**—*Precision Tool and Mfg. Co. of Illinois.* Full information and prices available on Deka drill. (Page 214)

A-6-142—**Clutches**—*Rockford Clutch Div., Borg-Warner Corp.* Typical installations of Rockford Clutches and power takeoffs contained in bulletin with complete diagrams of applications. (Page 142)

A-6-63—**Hobbing Machine**—*Russell, Holbrook & Henderson, Inc.* Bulletin RH-132-01 describes the new Mikron 15-second spacing accuracy spur gear hobbing machine. (Page 63)

A-6-154—**Carbide Tools**—*Sandvik Steel, Inc.* Complete catalog available on line of Coromant carbide cutting tools. (Page 154)

A-6-208-2—**Microscope**—*Geo. Scherr Co., Inc.* Circular contains complete story of the new type large tool makers microscope. (Page 208)

A-6-157—**Optical Tooling**—*Simpson Optical Manufacturing Co.* Literature describes the new Vernac direct reading optical measuring instrument. (Page 157)

A-6-232-1—**Bearings**—*Southwest Products Co.* Engineering manual No. 583 contains complete data on Southwest "Monoball" self-aligning bearings. (Page 232)

A-6-56—**Numerical Control**—*Stromberg-Carlson Div. of General Dynamics Corp.* Twelve-page booklet "Digimatic Model 202" contains complete details and illustrations on digimatic numerical control. (Page 56)

A-6-58—**Machine Tools**—*Sunstrand Machine Tool Div., Sunstrand Corp.* Bulletin No 704 contains information on how Sunstrand "Engineered Production" can solve machining problems. (Pages 58-59)

A-6-16—**Surface Grinder**—*Thompson Grinder Co.* Catalog T-553 contains data on Thompson Truform grinders. (Page 16)

A-6-221-1—**Drillheads**—*Thriftmaster Products Corp.* The copy of Thriftmaster catalog contains data on different styles of multiple drillheads. (Page 221)

A-6-224-2—**Balancing Machines**—*Tinius Olsen Testing Machine Co.* Bulletin 57 has data on the Rava Electro-dynamic balancing machines. (Page 224)

A-6-143—**Tracer Controls**—*True-Trace Sales Corp.* Complete data on synchro-trace control system contained in new illustrated brochure No. STM-1. (Page 143)

A-16-196—**Multiple Spindle Drill Heads**—*United States Drill Head Co.* Catalog AD-57 contains complete information. (Page 196)

A-6-172—**Gage**—*The Van Keuren Co.* Descriptive bulletin contains data on the new dimentional gage, the Van Keuren MYT size gage. (Page 172)

A-6-22—**Press Room Equipment**—*U.S. Tool Co.* Bulletin No. 85T shows how to obtain maximum flexibility and efficiency for your present press room equipment. (Page 22)

A-6-140—**Carbide Tools**—*Vascoloy-Ramet Corp.* Catalog VR-58 has complete details on carbide inserts and tool holders. (Page 140)

A-6-185—**Punching Units**—*Wales Strippit, Inc.* New Strippit general catalog covers details on the punching units with dual-range capacity and all other Strippit units. (Page 185)

A-6-216-1—**Abrasive Cut Machining**—*Wallace Supplies Mfg. Co.* Facts needed on cutting available in the new "Cut-Machining" book. (Page 216)

A-6-161—**Hardness Testers**—*Wilson Mechanical Instrument Division, American Chain & Cable Co., Inc.* Catalog RT-58 gives complete details on the full line of Wilson hardness testing equipment. (Page 161)

A-6-237—**Collet Arbors**—*N. A. Woodworth Co.* Collet arbor literature contains data on the Tork-Lok design for workholding tools. (Page 237)

A-6-160—**Rotary Slitters**—*The Yoder Co.* Illustrated book available on the Yoder rotary slitter lines. (Page 160)

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Field Notes

The manufacturing division of The Motch & Merryweather Machinery Co. has entered into a manufacturing agreement with Heller Brothers of Nuertingen, Germany which provides for the interchange of engineering data and technical information. Because the two companies manufacture many like machines, the new arrangement will materially assist Motch & Merryweather in its research and product development programs. Heller is one of Europe's largest machine tool companies and has been particularly successful in development of the building block principle of machine tool design.

new activities

An advanced product planning group has been established within the engineering department of Hamilton Standard, division of United Aircraft Corp., to discover product possibilities for the company in or out of the aircraft field. According to the announcement, the group "will seek specific products in the growing missile market, and in other markets, to which our skills and facilities as propeller and jet equipment manufacturers can be most suitably applied." The group will assess problems and predict market potentials connected with product ideas, and turn its recommendations over to management for final evaluation.

v v v

An international expansion program has been inaugurated by Lockheed Aircraft Corp. with plans for a new subsidiary company to develop broad aviation programs in foreign nations. The new organization, to be known as Lockheed Aircraft International, will coordinate the several programs now under discussion between the United States and foreign countries to broaden world markets for Lockheed products and services.

v v v

Six departments have been formed to carry out engineering functions of Consolidated Systems Corp., the recently formed, wholly-owned subsidiary of Consolidated Electrodynamics Corp. The new departments include process, data processing, instrumentation, electromechanical and industrial systems and field engineering.

Establishment of a corporate market research department has been announced by Vickers Inc., Div. of Sperry Rand Corp. It will provide a comprehensive market research operation to cover all needs of the company.

v v v

Greer Hydraulics, Inc. has established a products division with Leonard H. Seeman named to fill the post of manager.

v v v

Two developments in Landers, Frary & Clark's long-range modernization program have been accomplished. The company's Stanley vacuum products division has been transfered from the Center Street plant to the Ellis Street plant in New Britain; and all electric motor manufacture has been consolidated at the modern plant of the wholly-owned subsidiary, Handy-Hannah Products Corp. at Whitman, Mass.

association news

The American Society of Mechanical Engineers has extended the privilege of attending general ASME meetings without registration fee to members of 21 sister engineering societies. At conferences sponsored by the society's professional divisions, the same fee as for ASME members will be charged. The right, which has been granted as a step toward "unity of the engineering profession," extends to the groups represented on Engineers Joint Council or Engineers' Council for Professional Development. According to society president Glenn B. Warren, ASME hopes the step is helping to "demonstrate the community of interests shared by all engineers and is helping to lead the way toward greater liaison at the working level."

v v v

A $500 cash award plus a citation at the annual meeting will be given to the winner of the 1959 design contest sponsored by the Gray Iron Founders' Society. Second place award is $100 with a citation, and third through seventh prizes are $50 plus certificates of recognition. Primary purpose of the annual competition, which this year closes June 30, is to give due recognition to designers, engineers and buyers of gray iron castings. Entries are judged on how the design, or redesign did or could increase efficiency of the product; cost savings; potential commercial importance to the gray iron industry as a whole; or ingenuity of the design. Entry blanks and contest rules are available from the society office, 930 National City-E. 6th Bldg., Cleveland 14, Ohio.

v v v

Two new voluntary standards for definitions of regulator capacities and for measurement procedure for determining control valve flow capacity have been established by The Fluid Controls Institute, Inc. Single copies of the standards are being distributed gratis from the institute office at 320 Broadway, New York City.

moves

Esbec Barrel Finishing Corp. has moved to a new building at 190 Henry St., Bldg. 16 in Stamford, Conn. These facilities will provide additional space to accommodate continued expansion in all phases of the company's activities. All administrative, engineering, production and testing operations now will be consolidated under one roof.

v v v

Key personnel and plant equipment of Madison-Faessler Co. has been moved from Moberly, Mo. to Providence, R.I., home of the parent company, Madison Industries. This was the final step in a program aimed at organizing all production, service and sales operations through one centralized source.

acquisitions

Snyder Corp. has purchased Hope Machine Co. including all inventory stocks. The Hope machines will be engineered and built in Michigan plants of Snyder's Arthur Colton Co. Div. which also will service all Hope fillers now in the field. New machines in the line will be merchandised under the trade name of Colton-Hope.

v v v

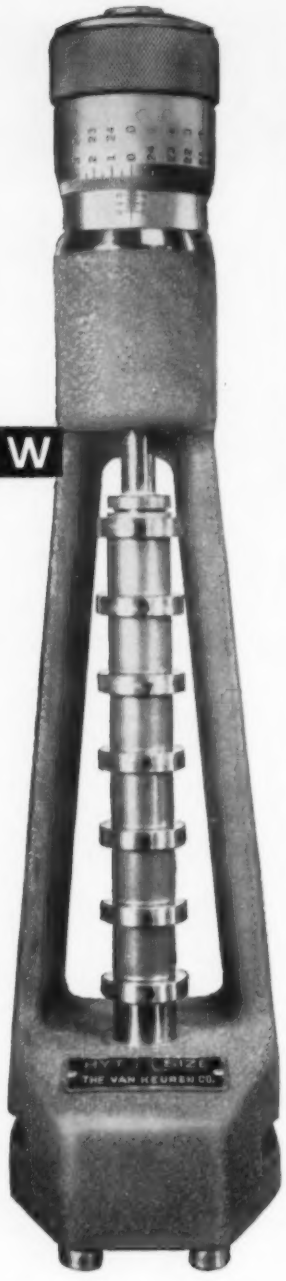
All tooling, drawings, and existing inventories for self-opening stud setters formerly made by Jones & Lamson Machine Co. have been purchased by Scully-Jones and Co. which will manufacture the entire standard line and provide engineering facilities to accommodate special customer design requirements.

v v v

Announcement from Hitchiner Manufacturing Co., Inc. has revealed its purchase of all assets of the Permattach Diamond Tool Co., Inc. The ac-

HYT Size Gage, 10" model

Available accessories:
18" transfer gage
3" and 6" riser blocks



Your surface plate needs this NEW dimensional gage, the **VAN KEUREN HYT SIZE GAGE**

Here's why:

- it embodies the well-known *Van Keuren precision.*
- it has a decided price advantage.
- permits amazing speed in setting all dimensions (a matter of a few seconds!)
- it's accurate to .000050" over entire range.
- has exclusive design features: a patented spring-loaded non-rotating spindle eliminates backlash . . . measuring surfaces are accessible from front and back . . . it can be used in a horizontal position.
- it's ruggedly built for long life.
- easily portable . . . can be used anywhere in shop.

Now you can more quickly inspect drill jigs, lathe fixtures, gears, cams, splines, profiles, contours . . . and check many shop operations. You can easily set precision depths on drill presses, milling machines, jig borers, etc.

Write today for descriptive bulletin

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PRECISION MEASURING TOOLS
. . . rated the world's most accurate
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quired firm will conduct business as a wholly owned subsidiary under the name of Permattach Diamond Tool Corp. It will continue its established lines and techniques as well as develop new and different products.

√ √ √

Vulcan Tool Co. recently acquired all patents, manufacturing and selling rights to Brehm Tube Cutting Machine and tube cutting dies from Steel Products Engineering Div. of Kelsey-Hayes.

√ √ √

Weaver Manufacturing Co. has been acquired in a cash transaction by Detroit Harvester Co. in order to broaden the company's output to include automotive service equipment. Weaver, which retains its corporate identity, will be operated as a wholly owned subsidiary of Detroit Harvester.

new facilities

Acme Industries, Inc. has opened a branch office in San Francisco as part of its program to improve distribution and extend markets. The new office will supervise Acme sales engineers in Washington, Oregon, Colorado, Nevada, Arizona, Utah, Idaho, New Mexico and Montana as well as California.

new companies

The Warner & Swasey Co. and Asquith Machine Tool Corp. Ltd. of England are jointly forming a new company for manufacture of the Warner & Swasey line of single spindle automatics for United Kingdom, European and other world markets. The company, which will be located in Halifax, England, will be called Warner Swasey Asquith Ltd. Warner & Swasey president Walter K. Bailey explained that his company will license the new firm to manufacture the machines to Warner & Swasey designs and under their patents. The machines will be built by Asquith for the time being in the present Halifax plant, and later in separate facilities to be provided by Asquith.

√ √ √

The Black & Decker Mfg. Co. has formed a subsidiary, Master Power Corp., which has acquired operations of the Master Pneumatic Tool Co., Inc. of Bedford, Ohio and Master Pneumatic Tools (Canada), Ltd. of Toronto. The transaction was financed by issuance of shares of capital stock of Black & Decker. The acquisition will expand Black & Decker's range of industrial products by addition of the complete Master line of pneumatic tools to its present line of electric tools.

Trade Literature

for free booklets and catalogs—use request card, page 169

Plastics for Injection Molding

Bulletin No. 5831 describes design concept in preplasticizing of plastics material in injection molding; explains "preplasticizing" and its advantages, and illustrates equipment and resultant products; covers specifications for five standard preplasticizers. The Hydraulic Press Mfg. Co., Div. of Koehring Co., Mount Gilead, Ohio. **L-6-1**

Tracing Attachment

Six-page Bulletin No. STM-1 describes economy features of Synchro-Trace automatic three-dimension programmed control system for milling applications. Well illustrated; includes outlines of applications from small toolroom to large planer type mills. Dept. SL, True-Trace Sales Corp., 9830 Rush St., El Monte, Calif. **L-6-2**

Carbide Drills

Bulletin No. 810 offers series of suggestions for most effective methods of gaining high production and long tool life from Hi-Roc solid carbide drills based on applications in industries ranging from aircraft factories to atomic plants; cover speeds, feeds, types and applications of coolants, bushings and chucks, setups etc. M. A. Ford Mfg. Co., Davenport, Iowa. **L-6-3**

Jig and Fixture Components

More than 500 components for jigs and fixtures and 250 clamping items are covered in 16-page catalog; includes full scale tracing templates plus dimensional drawings and photos, specifications and prices. Northwestern Tools, Inc., 122 Hollier Ave., Dayton 3, Ohio. **L-6-4**

Diamond Wheels

Revised 48-page illustrated catalog, Form ESA-290, on diamond grinding wheels outlines types and bonding processes; dimension and price tables for both man-made and natural diamonds plus table of recommended grain and grade specifications for grinding wheels for common operations performed in sharpening carbide tipped tools and grinding cemented carbides. Simonds Abrasive Co., Tacony & Fraley Sts., Philadelphia 37, Pa. **L-6-5**

Punch Presses

Illustrated literature describes Electro-Safe punch press series, emphasizing important safety features and production advantages of equipment; includes specification tables and dimensional diagrams. Kenco Mfg. Co., 5211 Telegraph Rd., Los Angeles 22, Calif. **L-6-6**

Tape Control

Illustrated brochure describes how tape-control system for automatic machine programming works and explains operational and cost advantages compared with conventional operation and with other types of control systems. Potter & Johnson Co., West Hartford, Conn. **L-6-7**

We can't turn back the calendar, but—
you can buy SAJO Millers today at the same price you paid for a comparable machine tool in 1949.

Time stood still...

Produced by Sweden's master craftsmen, these modern machine tools are engineered to maintain precise tolerances in continuous heavy-duty production. An example is the unique SAJO spindle construction employing SKF precision 2-row staggered roller bearings followed by thrust ball bearings, providing better load distribution and silent, vibration-free operation.

Built to U. S. standards, SAJO Millers are recognized for their accuracy, dependability and long life.

Condensed specifications:
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16 spindle speeds, 39-1500 r.p.m.
American Standard Taper No. 50
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feed motor 1½ h.p.

Accessories:
Universal Dividing Head, Rotary Index Table, Vertical and Universal Milling Attachments, Slotting Attachment, Vises, Arbors.

Also available:
SAJO Plain and Universal Millers, table size 41½"x9¼".

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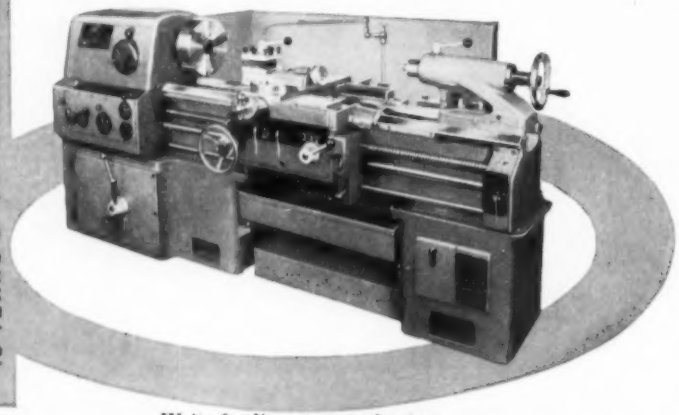
15", 17" and 22" models available.—Thousands in use, backed by our prompt and complete service.



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Punching, Drilling Equipment

Extensively illustrated with photos and drawings, 14-page brochure describes system of punching, notching, nibbling and drilling; includes description of the system as an outgrowth of the firm's self-contained stripping mechanism, and of the equipment contributing to economies afforded by it; also provides time studies of various fabrication operations using the system. Request only on company letterhead direct from Wales-Strippit, Inc., 211 S. Buell Rd., Akron, N. Y.

Plastic Tooling

Comprehensive Hysol Technical Bulletin T24A describes details of Hysol plastic tooling technique—a duplicating process eliminating double shrink patterns; explains advantages of the method, materials and use. Tooling Div., Houghton Laboratories, Inc., Olean, N. Y. **L-6-8**

Switches

Extensively illustrated with engineering drawings, 20-page Catalog No. 67, "Series 2 Lighted Indicator and Pushbutton Switch Devices," presents details of line designed for modern control panels; split pages allow quick selection and comparison of operator, indicator and switch units in the new series; includes technical information on lighting, indication, mounting and arrangement. Micro Switch, Div. of Minneapolis-Honeywell Regulator Co., Freeport, Ill. **L-6-9**

Tracer Control

Bulletin GEA-6122 describes tracer control system for variety of metalworking applications in vertical boring mills, skin milling machines, center drive or turret lathe, contour profile milling machines, etc.; shows how controls work and how they are used as complete system for economical machine operations. General Electric Co., Schenectady 5, N. Y. **L-6-10**

Media Storage

Bulletin No. 401 describes bins and pans for convenient storage and handling barrel finishing media; includes specifications, line drawings and illustrations, and brief installation explanation. Techline Div., Wheelabrator Corp., 1182 Avenue V, Vicksburg, Mich. **L-6-11**

Steel Inventory

"Steel Inventory Check Sheet", printed in film folder form, is designed to help steel users analyze various inventory practices; series of questions enables users to evaluate company's performance on basic inventory management. Solar Steel Corp., Hanover Div., 651 Lehigh Ave., Union, N. J. **L-6-12**

Automatic Assembly

Illustrated Bulletin 601 offers discussion justifying automatic assembly when low production rates or requirements are involved; describes methods of tooling machines with slow cyclic rates and design of equipment adaptable for production of different items; drawings and photos illustrate points discussed. Ferguson Machine Corp., 7818 Maplewood Industrial Ct., St. Louis 17, Mo. **L-6-13**

Linear Comparator

Four-page product Bulletin 170-58 provides detailed description of company's linear comparators used for measurement of spectrographic plates and similar records and its components; also illustrates other comparators in the line. Gaertner Scientific Corp., 1201 Wrightwood Ave., Chicago 14, Ill. **L-6-14**

Tracer Lathe

Automatic tracing cycles of Model 30 Auto-Tracer lathe, its design features and various components presented in 8-page brochure; explains operations and controls for quick set-up and includes specifications; well illustrated to show closeups of details. Jones & Lamson Machine Co., Advertising Dept., Springfield, Vt. **L-6-15**

Heat Treat Furnaces

Luminus wall combustion system for gas fired, infrared heat treating furnaces covered in 48-page technical Bulletin No. 209, "Instantaneous Heat"; uses layman's language to describe equipment, what it is, how it works, present applications and possibilities, versatility; includes glossary of terms as well as numerous drawings and prints for metallurgist and heat treating engineer. The A. F. Holden Co., 14341 Schaefer Hwy., Detroit, Mich. **L-6-16**

Fastener Fit Problems

Pocket-Sized folder 2422, "Common Thread Fit Problems . . . their symptoms and detection," calculated to solve simple production line fastener troubles, lists common fit problems, with possible causes of each and gaging devices needed to detect them. A. W. Scott, Box 786, Standard Pressed Steel Co., Jenkintown, Pa. **L-6-17**

Resistance Welding

Vol. 5, No. 4 of *Resistance Welding at Work* describes variety of resistance welding case histories, explaining production advantages and improved product quality obtained in each case with company's techniques; well illustrated. Sciaky Bros., Inc., Dept. L-24, 4915 W. 67th St., Chicago, Ill. **L-6-18**

Surface Grinders

Eight-page Catalog CGS-59 describes complete line of hand operated and hydraulic precision surface grinders; gives complete specifications and features; extensively illustrated. Landis Tool Co., Waynesboro, Pa. **L-6-19**

Cemented Carbides

Revised 32-page catalog on "Cemented Carbides for Industry" incorporates new and additional information on brazed tools, carbide inserts, tool holders and blanks; includes grade comparison charts and descriptions, speed and feed charts and grade recommendations, and prices; illustrated. Advertising Dept., Allegheny Ludlum Steel Corp., Oliver Bldg., Pittsburgh 22, Pa. **L-6-20**

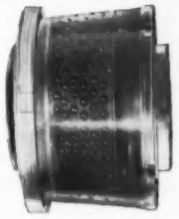
Lathes

Extensively illustrated with attention to details, 32-page brochure describes Series 62 Preselector Dyna-Shift Lathe, explaining design, construction, operation and advantages of each feature of the equipment; includes complete tables of specifications. The Monarch Machine Tool Co., Sidney, Ohio. **L-6-21**

Clutch-Pulley

Ten-page Electro-Sheave brochure describes in detail clutch-pulley package for direct installation on standard 1 to 25-hp electric motors; extensively illustrated with dimensional and cross-sectional drawings and photos; explains operation and selection. Warner Electric Brake & Clutch Co., P-52, Beloit, Wis. **L-6-22**

TOOLS
FOR INCREASING PRODUCTION



Compact—provides maximum fixture clearance when installed.

Anti-Friction Arbor Support Bearings

Simple to install—use these anti-friction bearings to INCREASE *arbor rigidity, tool life,* ELIMINATE *chatter,* and REDUCE *maintenance* costs. Only one bearing required for various arbor sizes. Standards for popular makes of milling machines.

ALSO—Free-running pilot bearings and combined linear-rotary motion spindle bearings designed and manufactured to order.

Precision Boring Heads . . . *adjust to TENTHS in SECONDS without loosening or tightening any screws*

Rigid construction and rapid tool adjustment without the use of indicators makes these heads ideal for close tolerance boring. Adjust to .0001 without loosening or tightening any screws—avoiding deflection. Standards and specials.

Size—Positive Adjustment Guaranteed

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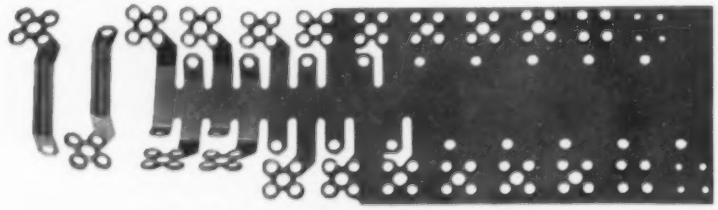
Steel Forgings

Fully illustrated with charts, graphs and photomicrographs, 40-page data book documents case history, mechanical property and machining tests of Hi-Qua-Led lead additive steel forgings; four principal sections deal with mechanical properties, special tests, machining and representative machining applications; covers tool life and tool geometry data, mill test data, physical and chemical properties, etc. Alco Products, Inc., P.O. Box 1065, Schenectady, N.Y. **L-6-23**

Nondestructive Checking

Illustrated 8-page booklet, "Norelco Autrometer, Automatic Indexing X-ray Spectrograph," gives engineering data on instrument employing universal detector and automatic crystal changer to provide fast nondestructive analysis method for up to 24 elements in a single sample; deals with applications, operating principles and procedures, performance, reproducibility, automatic programming, etc. Instruments Div., Philips Electronics, Inc., 750 S. Fulton Ave., Mount Vernon, N.Y. **L-6-24**



50 to 55 strokes per minute, 2 pieces per stroke, with Dickerman 9" Rol-Di-Feed. Stock .073 Cold Rolled Steel, width 7 7/8".

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65 strokes per minute on each of 3 presses, 3 Dickerman 9" Rol-Di-Feeds. Stock .050 Aluminum, width 14".

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Grinding Gages

Complete line of continuous grinding gages covered in 16-page Catalog 59A stressing important features and advantages; illustrated with photos and drawings to clarify details. Federal Products Corp., 1155 Eddy St., Providence 1, R.I. **L-6-25**

Clamp Templates

Three tracing templates of tool clamps and associated components created to assist in the design and development of test fixtures, milling fixtures, jig components and other tool engineering applications. PIC Design Corp., 477 Atlantic Ave., East Rockaway, L.I., N.Y. **L-6-26**

Carbide Tools

Engineering data on 1230 standard stock, solid carbide tools and burs presented in 148-page Catalog No. 159; includes speed and feed charts, machining recommendations for all tools and numerous metalworking production hints. The Atrax Co., Newington 11, Conn. **L-6-27**

Rotary Table

Circular presents detailed description of 24-in. tilting rotary table modified for sidereal rate of rotation; includes specification table. Pratt & Whitney Co., Inc., Charter Oak Blvd., West Hartford 1, Conn. **L-6-28**

Abrasives

Twelve-page illustrated Catalog No. 159 covers SAE specifications for all types of abrasive shot, grit and cut wire; lists important characteristics, considerations and uses for company's line of abrasives, and also includes methods and advantages of shot peening and impact cleaning and proper abrasive mixtures. Outlines quality control procedures. The Cleveland Metal Abrasive Co., 888 E. 67th St., Cleveland 3, Ohio. **L-6-29**

Press Brakes

Important features in line of mechanical press brakes presented in detail in 8-page, illustrated Bulletin No. D-59; includes complete specifications of 40 standard sizes in the series. Dreis & Krump Mfg. Co., 7400 S. Loomis Blvd., Chicago 36, Ill. **L-6-30**

Measuring Instrument

Well illustrated 4-page circular explains important features and advantages of precision Go-Devil monitor designed for use as a self-mastering comparator, measuring machine or dial indicator checker; includes specifications and possible applications. Go-Devil Instrument Co., 624 Dutchess Tpk., Poughkeepsie, N. Y. **L-6-31**

technical shorts

A POSITIVE system of maintaining tight, uniform time and temperature controls in heat treating furnaces has been developed in the research laboratories of the A. F. Holden Co. Instrumentation of the system, which the engineers refer to as "rationed heat energy," revolves around an electronic timer that can be preset at predetermined fix points for both time and temperature through two phases of the heat treating process. Controls of these two functions cannot be changed or tampered with once they have been fixed electronically and the furnace started.

Electronic Control System For Heat Treating

An example of the operation is a furnace in which phase one is set at 1000 F for 20 minutes and phase two at 1300 F for 20 minutes. The entire 40-minute cycle will be completed without interruption and without deviation from fixed settings for time and temperature.

Engineers found during a heat treating test on a cylindrical, 133-lb steel billet in a luminous wall, gas-fired furnace equipped with rationed heat energy controls, that fuel cost savings during a 180-minute heating cycle amounted to more than 16 percent. The engineers also point out the advantages of excellent equilibrium in heating, uniformity of heat penetration, minimum work distortion and absence of thermocouple failure.

Proper modifications of piping and wiring allow adaptation of the instrumentation and controls to any conventional heat treating furnace.

* * *

RESULTS FROM recent research indicates that ultrasonic vibrations can be combined with conventional welding methods to improve joining of metals. Scientists John N. Antonevich and Robert E. Monroe, working at Battelle Memorial Institute, say that the experiments with ultrasonic vibration reveal potential benefits for resistance welding, brazing and arc welding. By reducing surface tension of molten metals, it permits more intimate metal-to-metal contact. It drives out gas bubbles which weaken a weld and inhibits growth of crystal structures which make welds brittle.

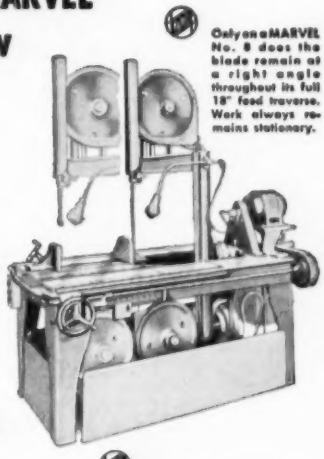
Add Ultrasonics To Improve Weld Techniques

Although the technique holds considerable promise, certain problems must be solved before ultrasonics can be combined with conventional welding according to the researchers. Ultrasonic vibration increases cooling rates of molten metals, and the weld may freeze too soon for desirable effects to occur. Another problem is that increased reaction rates may accelerate such effects as undesirable alloying. In addition, means must be found to deliver the necessary amount of energy to vibrations at the weld zone.

Besides possible use of ultrasonic energy in combination with conventional welding methods, "ultrasonic-welding" technique already used in some industrial welding operations shows increasing promise. In this process, parts to be joined are forced tightly against each other. A welding tip vibrating in the ultrasonic range is pressed against the spot to be welded, usually about three seconds. Frictional heat produced by vibration at the surfaces to be welded, plus the clamping force pressing the surfaces together, causes them to bond. Precise nature of this bonding is still being studied.

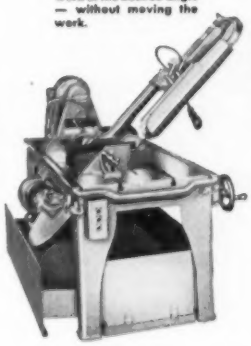
Never Confuse the No. 8 MARVEL with an ordinary Band Saw

...only the MARVEL is Universal



Only on a MARVEL No. 8 does the blade remain at a right angle throughout its full 18" feed traverse. Work always remains stationary.

Only on a No. 8 MARVEL can the saw column be instantly indexed and locked at any angle from 45° right to 45° left, and the saw then fed thru the work at the desired angle — without moving the work.



Only a No. 8 MARVEL can do all of these things: Snip-off a ½" rod or cut-off an 18" x 18" cross section.

Rough to Size and Shape

Miter

Index

cut off and shape Structural Beams

Slotting

Only a No. 8 MARVEL has the large T-slotted work table, with removable quick action vise, that permits accurate set-ups of work of unrestricted sizes and shapes, special fixtures; Etc.

"Rough Machine" to size and shape with minimun chip waste

The No. 8 MARVEL is the "busiest tool in the shop" wherever installed because it is a *universal* tool—has both the capacity and the versatility to handle not only standard sawing jobs but innumerable "trick" and convenience jobs as well. More than a metal saw, the No. 8 MARVEL is a fine machine tool with machine tool features like: Both power and hand feeds; Depth Stops; Automatic Blade Tension; Built-in Coolant Pump; Three operating speeds (or six with 2-speed motor). Moisture-proof electrical controls that conform to both "J.I.C." and "MACHINE TOOL" electrical standards; Dirt-proof ball bearings, etc.

If you cut, machine or fabricate metal, this is a sawing machine you should know about. Write for catalog.

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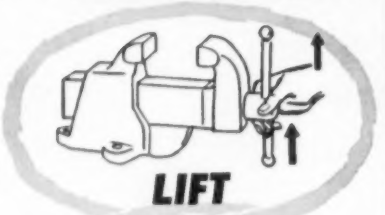

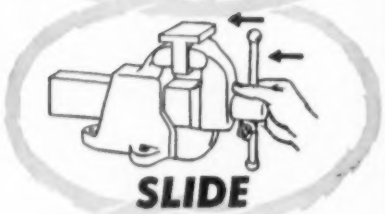

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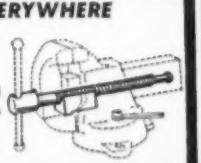

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who's meeting and where

June 7-12. PENNSYLVANIA STATE UNIVERSITY. Machinability seminar. Address inquiries to Dr. Inyong Ham, at the university, University Park, Pa.

June 9-12. THE MATERIAL HANDLING INSTITUTE, INC. 1959 Exposition, Cleveland Public Auditorium. Technical sessions sponsored by American Material Handling Society, Inc. with cooperative endorsement of the Society for Advancement of Management and the Material Handling Div. of the American Society of Mechanical Engineers. For details contact Material Handling Institute office, Suite 759, One Gateway Center, Pittsburgh 22, Pa.

June 9-19. PURDUE UNIVERSITY. Short course in quality control by statistical methods, university campus. Get more facts from The Statistical and Computing Laboratory, Purdue University, West Lafayette, Ind.

June 11-12. PRESSED METAL INSTITUTE. National sales seminar for metal stamping industry, Bedford Springs Hotel, Bedford, Pa. For more details, write to institute headquarters, 3673 Lee Rd., Cleveland 20, Ohio.

June 14-18. AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Semiannual meeting, Chase-Park Plaza Hotels, St. Louis, Mo. For further information write to ASME Meeting Dept., 29 W. 39th St., New York 18, N. Y.

June 14-19. SOCIETY OF AUTOMOTIVE ENGINEERS. Summer meeting, Chalfonte-Haddon Hall, Atlantic City, N. J. Society office, 485 Lexington Ave., New York 17, N. Y., can supply more information.

June 15-19. AMERICAN ELECTROPLATERS' SOCIETY. Golden jubilee convention and exposition, Detroit Artillery Armory, Detroit, Mich. Contact society office, 445 Broad St., Newark, N.J.

June 15-24. UNIVERSITY OF MICHIGAN Intensive course for practicing engineers on automatic controls, U of M campus, Ann Arbor, Mich. Get details from Fred Moncrieff, College of Engineering. University of Michigan, Ann Arbor, Mich.

Gaertner Toolmakers' Microscope used to measure typical piece part. Co-ordinate range 4" x 2".

Precise measurement to 0.0001" and 1 min. of arc

Gaertner Toolmakers' Microscope

Here is a reliable, easy-to-use microscope for precise measurement of piece parts, tools, dies, thread gages, templates, jigs, fixtures, etc. Ideally suited for making a wide variety of precision measurements and is especially valuable in reducing rejects in production work.

With the Gaertner Toolmakers' Microscope you make direct, non-destructive measurements — no contact, no distortion, images are sharp and clear. It is a basic measuring instrument for inspection depts., gage labs, tool and die and model shops, industrial and research labs.

The Gaertner Toolmakers' Microscope has been proven in use by U. S. Government Gage Laboratories, and by prime contractors and their subcontractors. With all parties using the same measuring instrument, inspection procedures are co-ordinated and disagreements and rejects minimized.

Features that help you get
HIGH SETTING AND REPEATING ACCURACY

- Low, compact built-in rotary stage reads to 1 minute of arc throughout 360° range.
- Minimum overhang of stages.
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Features that assure you of
EASY, CONVENIENT OPERATION

- Independently rotatable cross hairs in protractor ocular speed up measurements, simplify measuring procedure.
- Convenient location of ocular eyepieces for ease of reading.
- Built-in transformer and plugs for all illuminators.

Modifications and accessories to
MEET YOUR EXACT REQUIREMENTS

- Thread and radius templates, camera and spotting attachments, fine motion focus, variable magnification available.
- If you have a special measuring problem, our staff of representatives will be happy to consult with you. The service and engineering facilities of the manufacturer are always immediately available to help you.

Write for Bulletin 147-56

Designed and manufactured by

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INDICATE A-6-178-2

June 15-26. UNIVERSITY OF MICHIGAN. Course on standard methods of numerical analysis, university campus. Get other data from R. E. Carroll, Engineering Summer Conferences, University of Michigan, Ann Arbor, Mich.

June 16-19. CORNELL UNIVERSITY. Eight industrial engineering seminars, university campus, Ithaca, N. Y. Address inquiries for more information to J. W. Gavett, Seminars Coordinator, Upson Hall, Cornell, Ithaca, N. Y.

June 17-20. NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS. Annual meeting, Commodore Hotel, New York City. Society office, 2029 K St., N.W., Washington 6, D. C. can supply details.

June 18-20. AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Applied mechanics division conference, Virginia Polytechnic Institute, Blacksburg, Va. Obtain other details from society Meetings Dept., 29 W. 39th St., New York 18, N. Y.

June 19. SOCIETY OF PLASTICS ENGINEERS, INC., Detroit section. Technical meeting on plastics in the automotive industry. For information write to Chm. John Donalds, The Dow Chemical Co., 450 Fisher Bldg., Detroit 2, Mich.

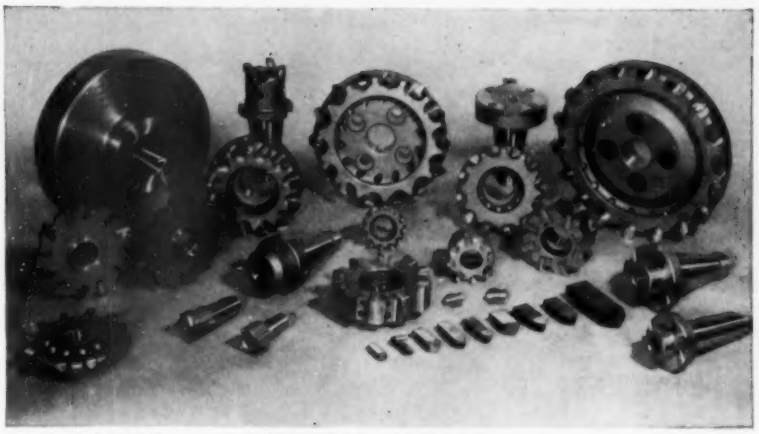
June 22-26. UNIVERSITY OF MICHIGAN. Course on application of stress analysis to design and metallurgy. For more information write to R. E. Carroll, Engineering Summer Conferences, 126 West Engineering Bldg., Ann Arbor, Mich.

June 22-26. AMERICAN SOCIETY FOR TESTING MATERIALS. Annual meeting, Atlantic City, N. J. Write to society office, 1916 Race St., Philadelphia 3, Pa. for more information.

June 25-27. PENNSYLVANIA STATE UNIVERSITY. Second biennial foundry conference. Further information is available from conference secretary, W. P. Winter, College of Engineering and Architecture, Pennsylvania State University, University Park, Pa.

June 29-July 3. PENNSYLVANIA STATE UNIVERSITY. Plastics engineering seminar. Get more data from Extension Conference Center, Pennsylvania State University, University Park, Pa.

June 29-July 10. UNIVERSITY OF MICHIGAN. Intensive courses on advanced numerical analysis, design of digital computing machines, and foundations and tools for operations research and management sciences. Details may be obtained from Fred Moncrieff, U of M, Ann Arbor, Mich.



Milling Cutters — End Mills — Blades — Boring Tools — Arbors — Flywheels

These Lovejoy Products can help you Cut Costs!

The entire line of Lovejoy Milling Cutters and Accessories is designed to aid you in getting better production at less cost.

If you are not now using Lovejoy products, we invite you to do so at first opportunity.

Lovejoy precision-engineered tools include:

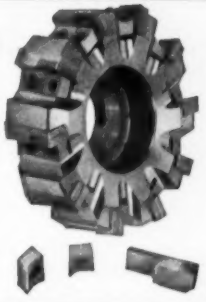
Inserted-tooth milling cutters (face, side, end, slotting and boring) which feature husky, forged steel housings; exclusive Lovejoy "positive-locking" blade assembly; a variety of dozens of models and hundreds of sizes.

Blades: H.S.S., Vasco Supreme and carbide. These are interchangeable over a wide range of housing sizes, and Type "A" face milling blades will fit any standard Lovejoy Type "A" cutter of 4½" to 24" dia. All Lovejoy blades are carried in stock, ready for immediate shipment. Special cutters are a Lovejoy specialty.

The New JOYDEX is a real performer!

Among the startling production reports coming in is a motor frame, rough-milled at 26 cubic inches per minute by an 8" diameter JOYDEX. Finish (with sweep blade) was 63 micro inches. Material was 115 Brinnell boiler plate.

Indexable throw-away blades, plus performance like the above, make the JOYDEX a joy to use—for operator, manager and treasurer. May we send you our latest spec sheet?



Catalogs — include: "Face Mill Catalog No. 31; Side Mill Catalog No. 32; Type "S" Bulletin; Arbor Catalog No. 33; "Speed and Feed" Calculator. Write today for copies desired.

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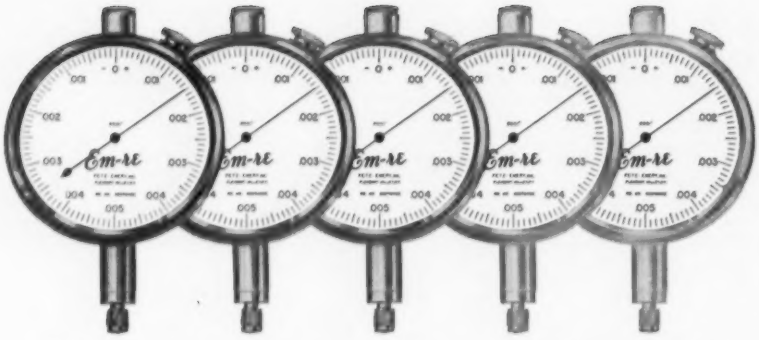

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The repeatability of "Em-re" Dial Indicators may not be quite as consistent as a photograph—but it comes mighty close! How close? . . . Well, "Em-re" Indicators will repeat consistently to an accuracy of 1/5 a graduation. On a .0001" indicator that's a repeated accuracy of .00002" (twenty millionths).

You need dial indicator performance like this to measure today's increasingly closer tolerances. With an "Em-re" you *can* measure to these closer limits—accurately and dependably. And "Em-re" accuracy permits an operator to use practically *all* of his allowed working tolerance. "Em-re" Dial Indicators are fully jeweled and completely shockproof throughout the entire range. They are now available in all four A.G.D. (American Gage Design) sizes, with 10 ranges from .002" to 1.000" and graduations in .001", .0005", .00025", .0001" and .00005".

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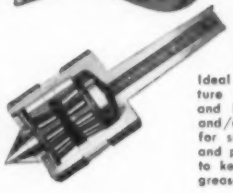

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good READING

A DICTIONARY OF METALLURGY—*By A. D. Marriman. Published by Pitman Publishing Corp., 2 W. 45th St., New York 36, N. Y. Price $25. 420 pages.*

Advancing technology demands precise definitions if techniques developed by engineers and researchers are to be communicated to others for additional research in the field. This book is a comprehensive work including the more recently evolved definitions found in atomic energy as well as the more general terms found in metallurgy and metallurgical research. This dictionary provides about 7000 definitions with ample cross references to insure that the reader will have no difficulty in finding the desired term. Included as appendixes are a table of common abbreviations and symbols, a table of abbreviations used in foreign literature and a table of physical properties and methods.

AUTOMATION IN MANAGEMENT—*By James R. Bright. Published by the Div. of Research, Graduate School of Business Administration, Harvard University. Price $10. 280 pages.*

Automation, with its aura and manless control of manufacturing activity apparently has potential significance for management. If the claims popularly made for automation are correct, it would appear that management would have to make important changes. This book is the outgrowth of field research to determine the impact of highly automatic production facilities on management. The study is divided into three parts, the first of which is the 'Nature of Automatic Manufacturing." Seventeen levels of mechanization ranging from hand operations to machines that anticipate the required performance and adjust themselves accordingly prior to the event are discussed.

Using the background of the nature of mechanization, the second part, "Experiences with Automation" is developed. The background and technique of 13 automation programs with such diverse manufacturing activities as automobiles, engine plants, a feed mill, fertilizer plant, an oil refinery, a bread bakery, a coal mine and electrical parts manufacture plant are included. The variety of objectives and motives of automation in these plants is

found surprisingly broad. Advantages of the equipment lead to (1) a reduction of costs, (2) operational improvements, (3) improvements in working environment, and (4) product advantages, as well as a striving for survival. These areas comprise the major categories for industry's motivation toward automation.

The third part of the book deals with the four "Critical Areas of Automation"—maintenance, labor, sales and management itself. Since down time is costly in automation, it is something that must be carefully planned and may even become a major managerial responsibility. The book contains a thoughtful interpretation of experiences of industry in this field.

DESIGNING FOR PRODUCTION—*By Edward N. Baldwin W. Niebel. Published by Richard D. Irwin, Inc., Homewood, Ill. Price $8.40. 660 pages.*

Principal engineering materials as well as manufacturing processes are described in this book from the product design viewpoint. Information is presented to help the designer select a material best suited for his design with respect to processing, service life, first costs and maintenance requirements as well as function.

The standard manufacturing processes including metal forming and shaping, cutting, joining, finishing, inspection, assembly and packaging are described and analyzed. Other sections include a general discussion on patents and case histories of improved products. In the case history section, the history of the product being studied is discussed, planning its design, experimental work, redesign for production and comments on the case history. Actual studies on the improved design and selection of properties for a new product are illustrated.

INTRODUCTORY GRAPHICS—*By J. Norman Arnold. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. Price $7.75. 555 pages.*

Graphical solutions to engineering and mathematical problems are emphasized in this engineering drawing book. It is designed to help the student in the graphic representation of objects, data and physical phenomena as well as the solution of space and graphical analogue problems.

ADMINISTRATION OF SALARIES AND INTANGIBLE REWARDS FOR ENGINEERS AND SCIENTISTS—*By John W. Riegel. Published by Bureau of Industrial Relations, University of Michigan, Ann Arbor, Mich. Price $6. 214 pages.*

Need for the services of engineers and scientists appears to be greater in the immediate future than at any other period. A study of their utilization and motivation is most timely. This book reports the findings of such a study. On the basis of it, the author suggests ways to motivate these men to do their best work.

Now...B & S Offers 20% Savings on 80% of End Mill Applications!

Thriftmill *Brings "Throw Away" Tool Concept to End Mill Operations!*

Why is the initial price of the NEW B & S Thriftmill 15 to 20% less than conventional end mills at a time when most other metal-working costs are rising?

This is a new exclusive design, a product of B & S progressive engineering and manufacturing techniques. The Thriftmill can be produced faster, more efficiently and therefore costs less.

Demand for the new Thriftmill is so phenomenal—large volume production lowers manufacturing and distribution costs.

Shop tested on profiling, slotting, peripheral milling and many other general end milling operations, the Thriftmill excels in over 80% of production applications. The new Thriftmill may mean new end milling economy and efficiency for you.

Ask your Distributor about the New B & S Thriftmill today! Send for new CONDENSALOG—easy to use specifications and prices on over 3300 "standard" cutters and end mills to: *Cutting Tool Division, Brown & Sharpe Mfg. Co., Providence 1, Rhode Island.*

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NELCO CARBIDE TOOLS
END MILLS

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NEW

a super-hard cemented carbide for high speed, high precision machining of steel

CARMET CA604

now added to Carmet's crater-resistant 600 series

Here's a new product of Allegheny Ludlum research to help you meet today's demand for high speed machining of steel. It's an ultra hard tungsten carbide with unusually high crater resistance, wear life and high strength at high cutting temperatures. CA604 operates in the fast cutting ceramic areas, combines high velocity finishing with light to medium feeds. Field tested for more than a year, CA604 is offered in Indexable Inserts and blanks for mechanical holders.

CARMET OFFERS A CARBIDE GRADE FOR CUTTING ANY STEEL ALLOY

CA 604
Extra hard for high speed, high precision machining.

CA 605
For fine finishing and high velocity cuts of steel.

CA 606
For lighter cuts on all steels and magnetic alloys

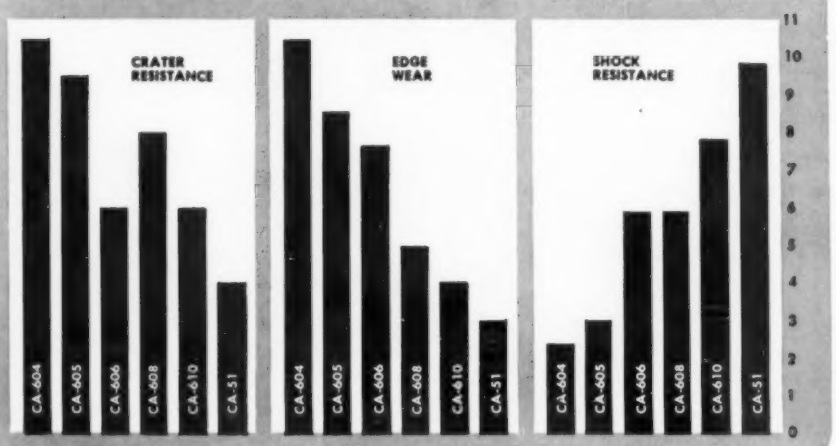
CA 608
For light cuts on all steels; crater resistance.

CA 610
General purpose steel cutting; high shock resistance.

CA 51
For heavy, interrupted cuts; high shock resistance.

Relative Characteristics of Carmet Metal Cutting Grades

This chart shows how grades in the CA-600 Series compare in crater resistance, edge wear resistance and shock resistance. The units of measurement indicate only relationship between grades, not efficiency.



Write for new Catalog C-16

Carmet Cemented Carbides for Industry

This 32-page first edition contains prices and complete specifications on Carmet's full line of cemented carbide tipped tools, Indexable Inserts, blanks and holders. Speed and feed charts, grade comparisons and ordering information included.

ADDRESS DEPT. TE-181

Your Carmet Distributor carries Carmet standard tools, holders, and Indexable Inserts in stock, assures prompt delivery and will aid you in selecting the proper grades and styles for economical machining. Call him today or write Allegheny Ludlum Steel Corporation, Carmet Division, Detroit 20, Michigan.

WSW 7897A

CARMET

CEMENTED CARBIDE DIVISION OF
ALLEGHENY LUDLUM STEEL CORPORATION

Design Factors Affecting Machine Efficiency

Tech Digests

By Kurt O. Tech

Vice President Engineering
The Cross Co.
Detroit, Mich.

IN PREPARING for an automatic production operation, the degree of planning that goes into two important areas helps determine the final efficiency of the production facility. They are:

1. Processing the parts to be manufactured for optimum efficiency and economy—consistent with production and quality requirements
2. Establishment of specifications for machine tools, or the selection of machine tools and allied equipment that satisfy definite requirements in addition to ability to perform operations processed.

These two phases of preproduction planning can be a source of added profit or dissipated profit. It depends on the length of planning, analysis and forethought going into each area.

In processing, this planning in depth is usually achieved. In selecting machine tools or in setting machine tool specification, a number of considerations are treated superficially or overlooked that contribute to the ultimate efficiency, economy and trouble-free operation of such production machine tools. Some of those overlooked include factors in flexibility, accessibility, tool changing, electrical arrangement, work height and indentification.

Flexibility: In its simplest terms, flexibility is provided by maximum interchangeability of major and minor machine tool parts and components. Such interchangeability is facilitated by maximum standardization in design, dimensions and tolerances. There are three areas of standardization which lead to flexibility in machine tools. They are (1) industry standardization; (2) builders' standardization; and (3) custom standardization.

Industry standardization takes in all standards developed by the machine tool and allied industries over a period of years. Screws, electric motors, toolholders, machine tapers and chucks are typical of many of the items. *Fig.* 1.

Not as well known, but of great importance in achieving flexibility in production machine tools, are machine toolbuilders' standards. They have been developed by individual machine toolbuilders for the purpose of providing greater interchangeability between components of machines. Components which have been standardized in this way are standard way type feed units, quill type feed units, wing bases, columns, center base sections, as well as transfer mechanisms.

Development of standards by progressive machine toolbuilders has resulted in a new concept of machine construction commonly called the "building block" concept. Properly developed these standards should provide the following features:

1. Identical hole patterns for mounting all units to the machine base including wing bases, brackets, columns or any special units which may be required
2. Keyed location of units to the machine to permit shifting of units from station to station in a minimum time and with complete accuracy.
3. Provision for complete utilization of all idle stations on the machine at a future date without any need for additional machining.

Fig. 2 shows a portion of a transfer machine illustrating all of the above features. It is important that these standards provide true interchangeability. Many times building blocks are constructed to tolerances which do not permit their interchangeability. It is common practice to manufacture building blocks to a standard and then remachine at assembly in order to make them fit the machine. This destroys much of their value as flexible components. When flexibility is your goal in machine tool planning this interchange-

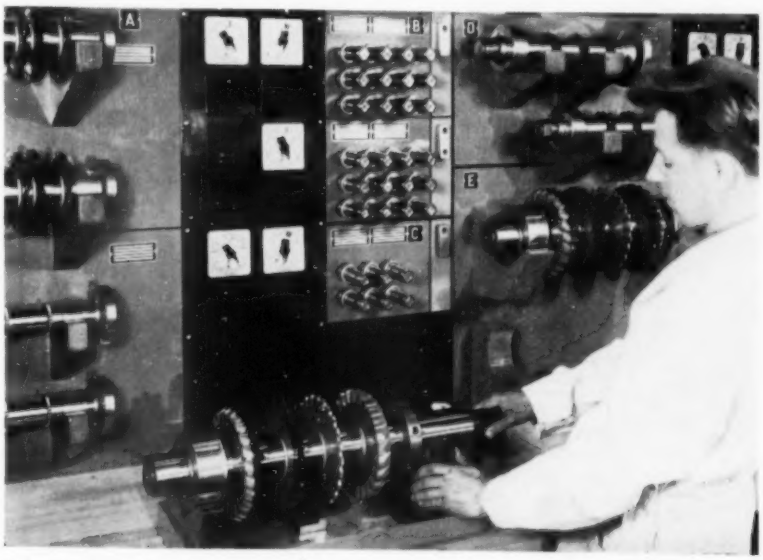


Fig. 1. Control unit used in conjunction with a transfer machine to signal the operator that a tool needs changing. On the same unit, tools are preset to reduce the machine down time to a minimum during maintenance.

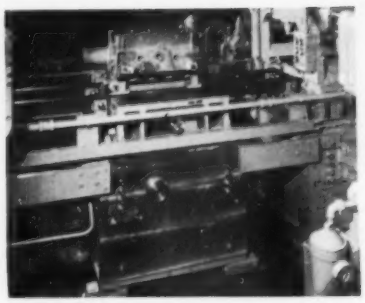


Fig. 2. Portion of a transfer machine illustrating the use of standardized hole patterns and keyed locations for changes.

ability should be carefully studied.

Standardization of custom components within a specific machine is usually even less well known and considered. It usually revolves around fixturing and other components which are directly related to the part being machined. Standardization of locating pins in all fixtures throughout a transfer line would probably be the most commonly known standard of this type. Yet, there are many lines in which this standardization was not achieved.

Common hole patterns for mounting all fixtures on one or more transfer lines are another illustration of this type of standard. They make it possible to easily move fixtures from one section to the other.

Designs incorporating separate simple bushing plates with a standard interchangeable hole pattern mounted throughout the machine is another example of machine standards. Use of this standard bushing plate permits the addition of holes, the moving of holes in any station, or shifting complete stations in the machine with a minimum of machine disassembly, a minimum of cost where parts must be scrapped, and without any changes to major machine components.

A good illustration of the benefits derived from optimum flexibility through standardization in machine design occurred on two transmission case lines recently installed. The two lines were developed for production of four aluminum automatic transmission cases. One line, designated as the short line, was designed to produce Case *A*. A second line, called the long line, was designed to simultaneously process all four cases (*A*, *B*, *C* and *D*) without any changes in machine setup. This versatility was achieved by means of sensing devices in the machine that direct the flow of the various cases through the line and where required actuate machine and material-handling units.

Since these machines were installed, two major changes in production planning have taken place. Because of changing sales requirements, transmission Case *B* became the high production case. The short line therefore was converted from processing Case *A* to processing Case *B* at the cost of only 2.3 percent of the original capital equipment cost.

In addition, a new transmission Case *E* has come into being and the long line was altered to handle this case—in addition to the four original cases—at a cost of only 2.8 percent of the original capital equipment cost. All of this was made possible without affecting the production rate of either line because the design incorporated the flexibility features just described. Most important were the custom standards developed for this particular line.

Accessibility: While a machine must be designed to perform the maximum amount of work in the minimum amount of floor space, decisions relating to "size" are rarely clear cut. In many cases, allotment of slight additional floor space will reap great rewards in machine efficiency by providing sufficient space for proper accessibility.

Since maintenance factors determine machine efficiency, every consideration must be given to minimize frequency of down time and, more important, minimize the amount of time it takes to put the machine back into operation once it is down. Accessibility is one of the most important provisions in machine design to effect shortest possible down time.

Tool Changing: Since tool changing is the one greatest cause for machine down time, every provision should be

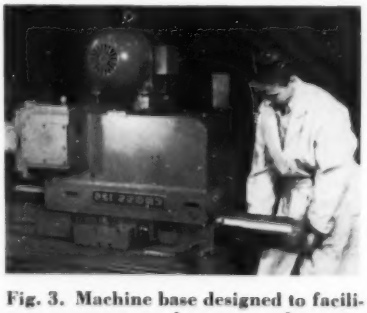
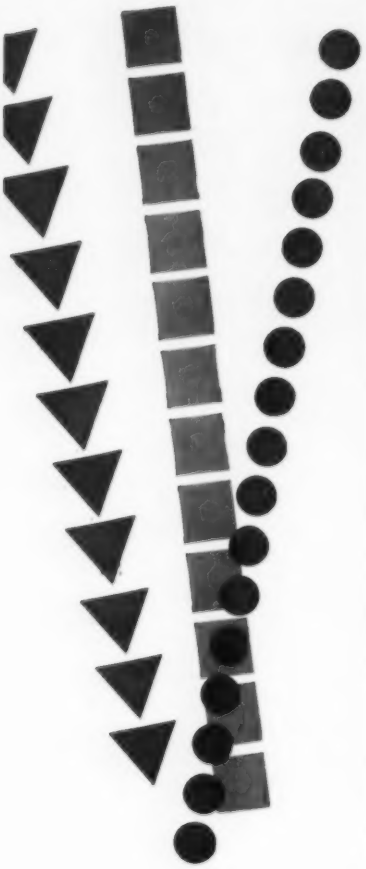
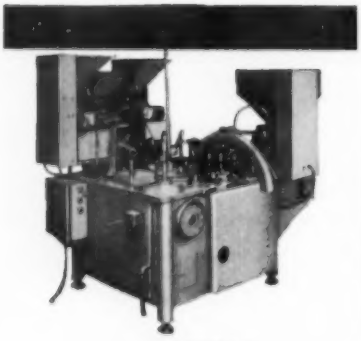


Fig. 3. Machine base designed to facilitate component changes so the units can be removed without taking off heavy parts.





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made to expedite changing. This can be achieved in the planning stages by adopting quick change, preset tooling wherever possible and in providing inspection and tool setting off the machine. "Ready" tooling should be stored close to the machines on which they are employed with machine control units similar to the one with tool setting gages shown in *Fig.* 1. Tool change systems in transfer machines are not inherited with transfer machine installations, they must be planned.

Electrical Arrangement: The planning and design of the electrical control system, together with the control console, is another key factor to be considered. The basic design of most control systems for operating machines automatically are quite similar. However, the system must satisfy certain "maintenance" requirements. In a machine as complex as a modern transfer installation, failures will sometimes

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occur and it is essential that such failures be located quickly and corrected.

Proper control panel arrangement is also necessary to reduce the time required in trouble shooting. Building-block arrangement in control panels pays great dividends. First, it provides the same flexibility for rearrangement of machines as was pointed up earlier on mechanical components. In addition, it results in a control cabinet consisting of multiples of one or more simple circuits, rather than a cabinet containing one large complex circuit.

Work Height: Important factors to be considered in machine planning and design are work height and structural rigidity. These factors must not be compromised for such considerations as operator loading heights or existing conveyor heights. Many times, such restrictions seriously affect machine rigidity and proper machine proportions with the base elements. Space must be provided through the machine for chip conveyors, automatic lubrication systems, coolant systems, hydraulic systems and air lines without sacrificing needed rigidity.

Identification: In any complex machine tool proper identification of components is important. Almost any type

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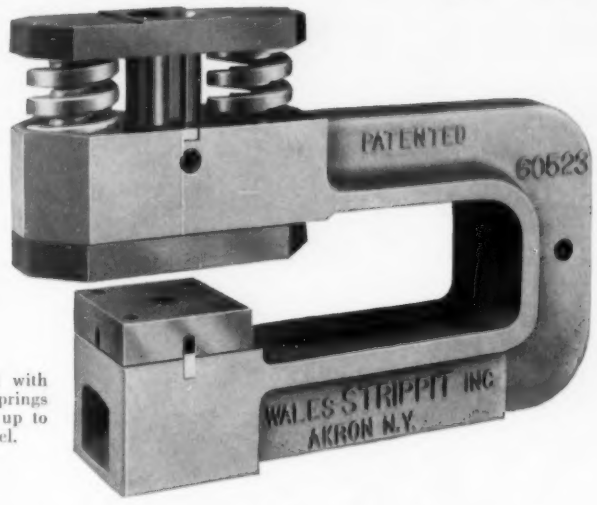

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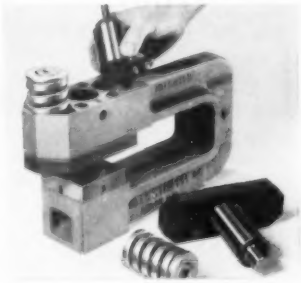
1.125	.625
1.000	.750



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of maintenance requires that a maintenance man identify either the component upon which he is working or the proper function of that component in the machine tool. This information does no good on drawings in the files of the manufacturing department or the plant engineering department. It must be available on the machine at the component on which the trouble occurs.

This can be achieved only by proper tagging on the machine, not on the component. Valves, limit switches and cylinders must be tagged for function, for identification in the hydraulic or electrical circuit, and for purchase specification. Relays, timers, starters, wires and hydraulic lines must be identified so that they can be used to trace circuits.

Successful machine designs are achieved only through careful attention to the details. This holds true on both simple and complex machines. It is important in planning for new production facilities to analyze in depth—to be positive that the tremendous trifles that are so important to machine efficiency will be working for and not against us.

Based on a paper presented at the National Production Meeting of the Society of Automotive Engineers, Inc., 485 Lexington Ave., New York 17, N. Y.

▼ ▼ ▼

Low-Temperature Applications

By Joseph Meisler
Philips Electronics, Inc.
Instruments Div.
Mt. Vernon, N. Y.

Low Temperature Steel Hardening: The tool industry uses low temperature quenching for dimensionally stabilizing such precision items as gages, cutlery and surgical instruments. Extreme stability is effected by cooling the parts to minus 150 F or lower. At this low temperature, the steel is hardened by the almost complete transformation from the austenite to the martensite state. Instead of storage for a number of years, stability can be effected in a matter of hours.

Considerable improvement in tool life has also been reported as a result of incorporating a cold treatment into the heat-treating cycle. For example, cold forging dies of 1 percent carbon, 5 percent chromium, 1 percent molybdenum steel for the production of screwdrivers were hardened to R_C-60 by ordinary procedures without danger of cracking. By refrigerating these dies below minus 150 F for 10 hours and re-

tempering them at 200 F, hardness increased to R_C-65 and the life was doubled.

Shrink Fitting Assembled Parts: Contraction by refrigeration has become an important method of obtaining close-fitting parts. It avoids the danger of softening heat-treated parts which is possible if heating is used to expand the female member of the assembly.

Aging of Aluminum and Magnesium Alloys: Some aluminum alloys are softened by quenching from a suitable temperature and develop their maximum strength by precipitation hardening after this treatment. This precipitation hardening or aging occurs at room temperature and makes the alloy difficult to work. Aging can be retarded by storage at low temperatures. The latter has been applied to aluminum alloy hydraulic valve castings. Before treatments were employed, many parts were spoiled by tearing during drilling and tapping, and were frequently distorted severely. After refrigeration below minus 150 F, the valves could be drilled and tapped without tearing and close dimensional tolerance could be held.

Other Applications: Chilling of stainless steel to minus 250 F and lower temperatures prior to forging or rolling increases its strength and hardness.

Much interest was recently shown in the use of Norelco cold chambers for the afore-noted metallurgical applications. Test results using the 13-cubic-foot capacity proved very satisfactory. Thus, a charge of 150 pounds of metal placed in the box at ambient temperature was cooled down to minus 200 F in less than four hours; with a maximum charge weighing three tons, the time was two days.

Based on a paper presented at the 1958 Cryogenic Engineering Conference at Boston, Mass.

▼ ▼ ▼

Dynamic Structural Test

By Gerald Klaasen

Chrysler Corp.
Detroit, Mich.

Stress levels associated with these dynamic loadings seldom cause difficulty in modern automotive body structures. However, the accompanying deflections must be carefully evaluated to avoid car-shake problems.

To achieve a body structure which

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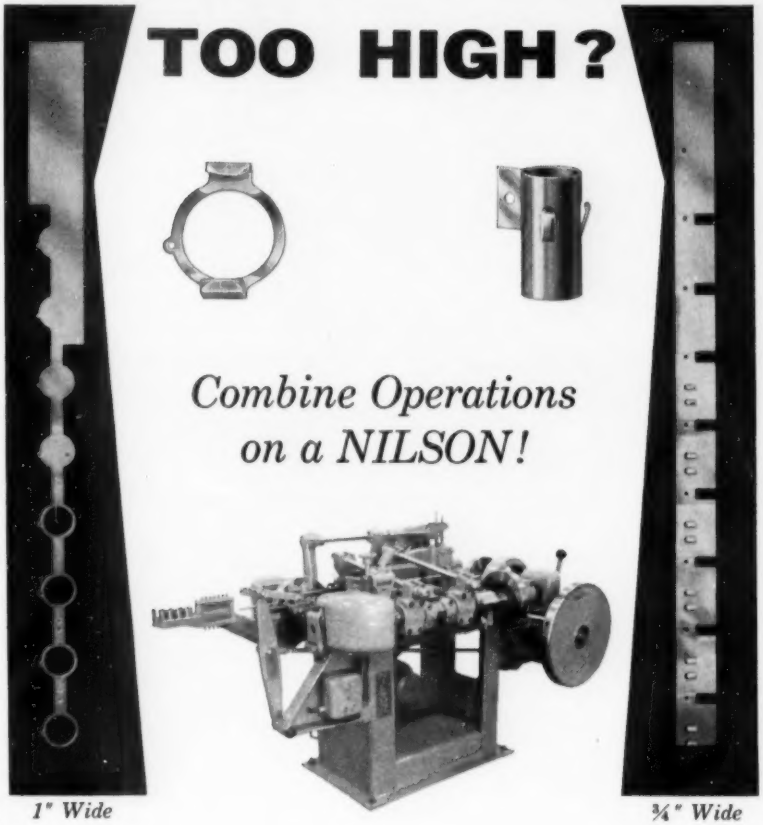

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has over-all soundness and yet is light in weight, it is necessary to know the answers to the following questions:

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3. Are the dynamics of the engine on its mountings such as to absorb the maximum amount of energy from the structure at shake frequencies?
4. Does the suspension do as good a job as can be expected from it in minimizing the magniture of forces which it puts into the structure?
5. Are these forces transmitted into the structure at such locations and in such directions that they will evoke minimum structural response?

Electronic testing equipment plays a very important part in answering these questions.

Based on a paper presented at the National Passenger Car, Body and Materials Meeting of the Society of Automotive Engineers, Inc., 485 Lexington Ave., New York 17, N. Y.

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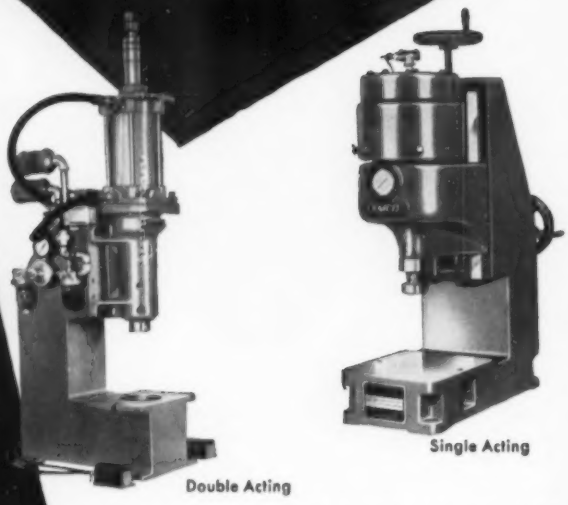

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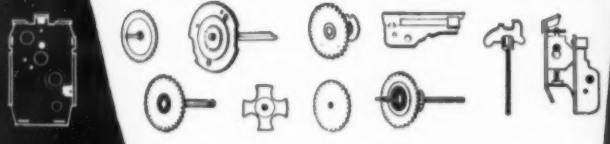

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Sacio

Dr. Arnold D. Hestenes

Director
Operations Research Section
General Motors Corp.
Detroit, Mich.

The expression "Sacio," coined specifically for this discussion means storage, arithmetic and logic, control, input, and output. These five items are the basic components of a modern electronic computer. These five components are interrelated.

The electronic computer is a very powerful but versatile tool. Its repertoire of instructions contains a set of decision elements. Through the use of these decision elements, the computer can change its course of action during processing, depending on the results of the processing itself. This ability has given the computer the name "electronic brain." In reality, however, the computer can select only one of a set of predetermined courses of action; therefore, it is the analyst who prepares the program who must recognize and prepare adequate solutions to all possible alternatives.

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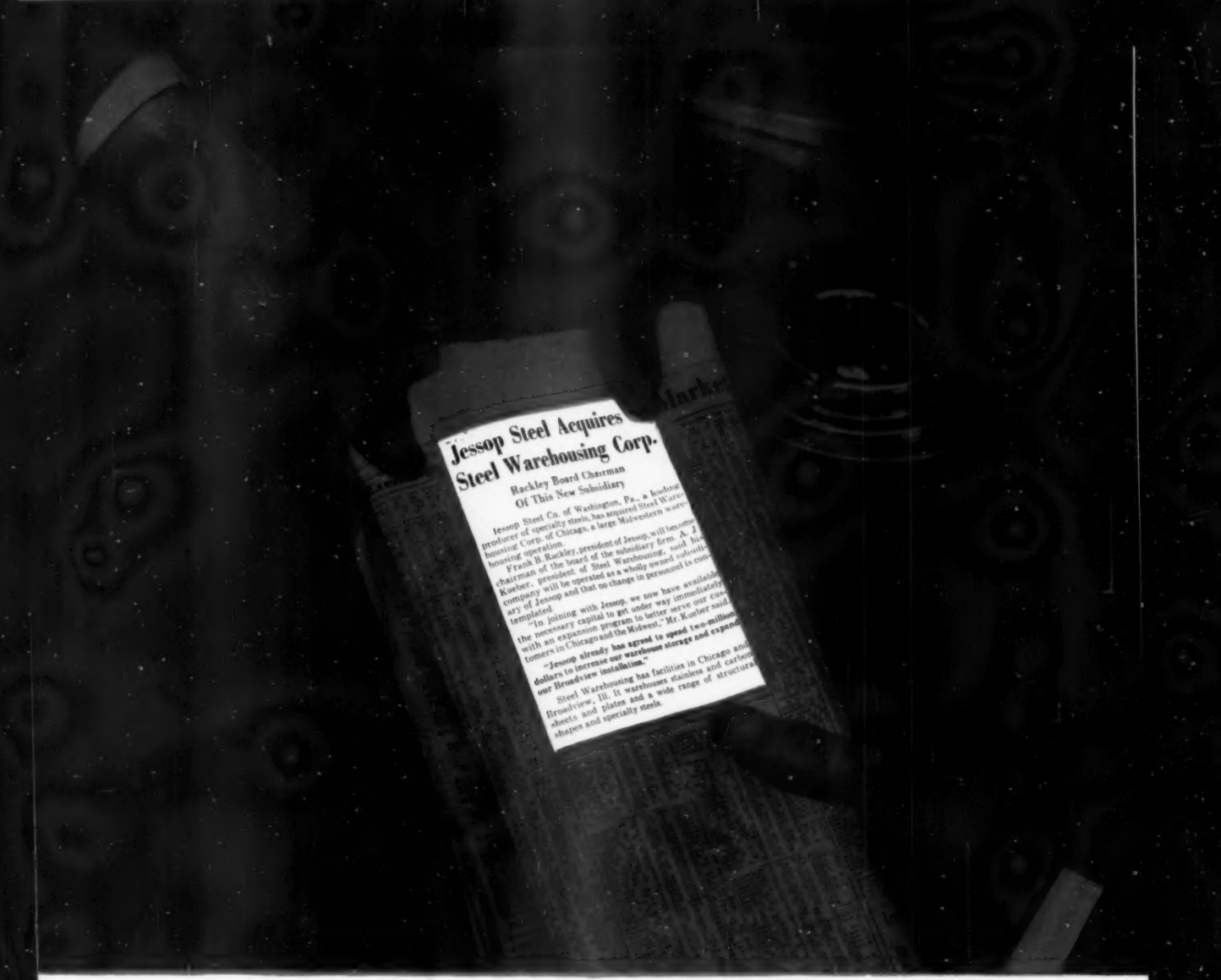
The fact that the instructions are stored within the memory in coded form provides the ability to alter and/or create instructions as the program progresses. The computer can recognize a group of characters as an instruction or as a collection of data. The operations provided are applicable to the characters which form an instruction just as well as to characters which represent data. Consequently, computers have the ability to modify instructions.

The speed with which these computers operate is the speed of electronics and is measured in millionths of a second. Therefore, jobs which require weeks or months by manual methods can be done in minutes by electronic methods. Not only are these machines fast, but they are fantastically accurate. Electronic data processing is by far the most accurate method of data processing and scientific computing which is known or in use today.

Based on a paper presented at the National Production Meeting of the Society of Automotive Engineers, Inc., 485 Lexington Ave., New York 17, N. Y.



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Hundreds of parts machined, plastic molded, stamped...

YET I-T-E'S INSPECTION FORMULA GUARANTEES PRECISION AS PRODUCTION RATES MULTIPLY!

Optical gaging inspects these tiny circuit breaker parts, in some cases seven times faster than hand methods. Permits more thorough, often more accurate, inspection of linear dimensions, hole diameters and locations, radii, angles and contours.

"We've found a practical method to retain precise quality in the many small parts we make to go into our circuit breakers," says the Small Air Circuit Breaker Division of I-T-E, in Philadelphia.

"That method makes *full* use of optical gaging with our Kodak Contour Projectors. They're in constant use to improve our quality and avoid production headaches at the same time.

"Starting in *receiving*, all components from our suppliers are optically checked to save later production snags. Tool and die samples and experimental parts in the *tool room* are optically checked. And finally, we inspect parts right in the *production* line. This way, inspection bottlenecks just don't happen."

Here are just a few reasons why I-T-E and other firms find inspection with a Kodak Contour Projector fast and accurate:

Parts and fixtures are easy to set up, even large parts.

You have a constant 8" of working space regardless of magnification.

You can easily see and check what you're inspecting because there's brilliant, uniform illumination over the entire screen area, and the image is always erect and unreversed—at any magnification you select.

To learn more about these and other features of the Kodak Contour Projector and how they can ease your inspection problems, write for the booklet, "Kodak Contour Projectors."

Special Product Sales

EASTMAN KODAK COMPANY, Rochester 4, N. Y.

the KODAK CONTOUR PROJECTOR

Kodak
TRADE MARK

Revolutionary new grinding and shorpening method! In one setting and in one operation the pilot and the relief angle can be ground. Any required pilot. Standard drills made into pilot drills fast and economically!!

Fast and simple setting for grinding multiple step drills using standard two-lip or three-lip drills. Accurate pilot diameters and pilot lengths obtainable with dial indicator set-up.

Two-lip, three-lip and four-lip drilling and countersinking tools can be ground fast, simple accurate and economically.

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The new

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USE READER SERVICE CARD; INDICATE A-6-194-1

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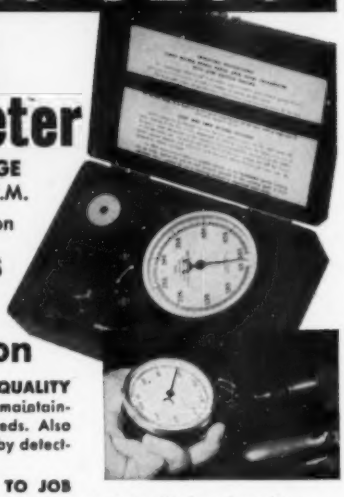
BROAD RANGE
50 — 5,000 R.P.M.
with stop button

assures better production



HIGHER OUTPUT — QUALITY CONTROL obtained by maintaining proper machine speeds. Also helps avoid breakdowns by detecting irregularities.

CARRY IT FROM JOB TO JOB and keep it handy for quick, accurate tests. Choice of readings in R.P.M., F.P.M., etc.

GUARANTEED ACCURACY—superior construction, trouble-free. Unaffected by moisture, temperatures, electric currents.

Many other Portable and Stationary Models, indicating Speeds between 50 R.P.M. and 50,000 R.P.M., are available.

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JONES MOTROLA CORP.
Stamford, Conn.

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ACCURACY .0002 T.I.R.

.0002 T.I.R. or less at Spindle Nose, .0005 T.I.R. or less on Test Arbor six inches from Spindle Nose

SPINDLE SPEEDS 150 and 250 RPM Other Spindle Speed Pulleys Available

MODEL B943 MOTOR DRIVEN WORK HEAD

No. 11 B & S Tapered Spindle Standard Equipment. No. 12 B & S or No. 5 Morse Available at Slight Extra Cost.

Clip ad to your letterhead and send for Literature

K. O. Lee Company, Aberdeen, S. D.

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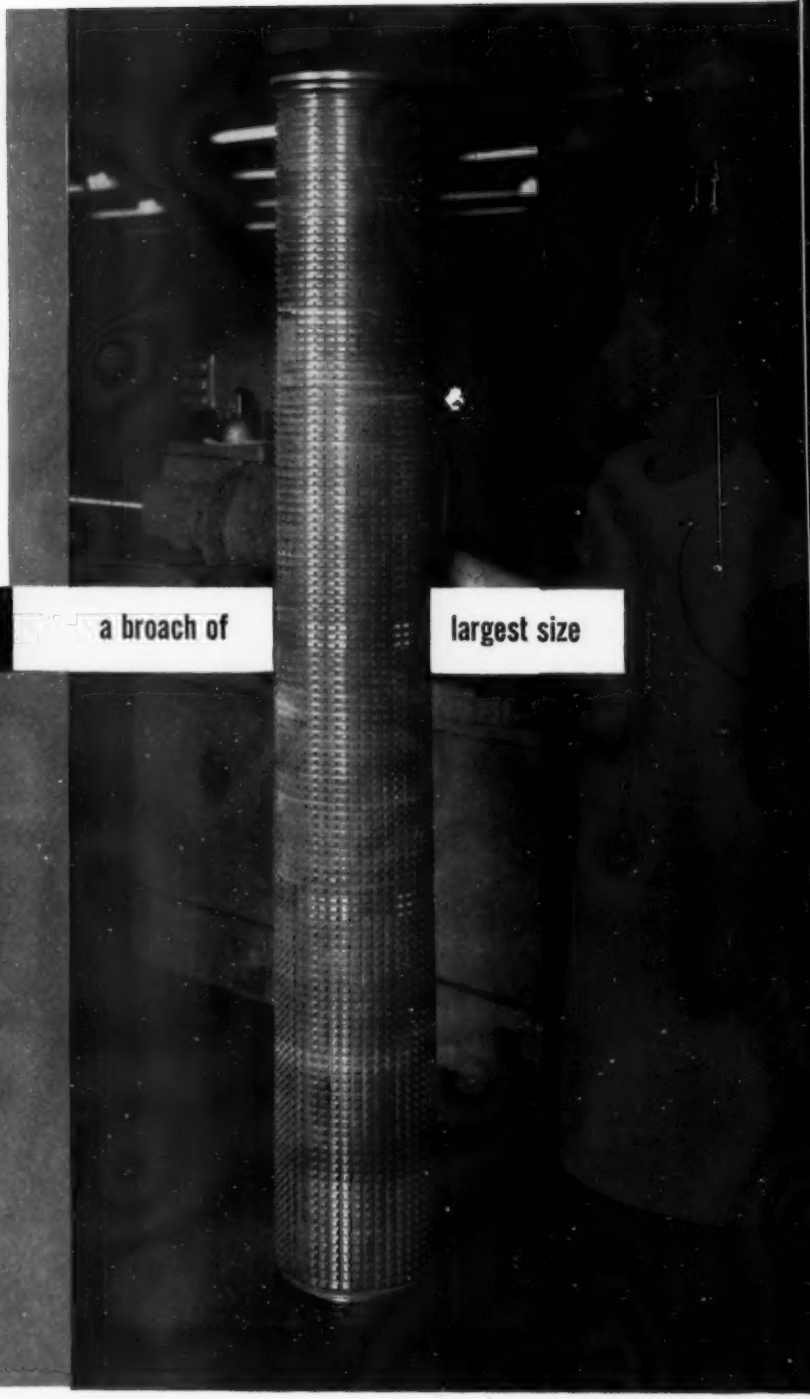
a tiny milling cutter



a broach of

largest size

the quality is identical because the steel is VANADIUM-ALLOYS

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- Van Lom
- Neatro
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FIRST QUALITY has a diamond-clear meaning when applied to our steels. It is a term expressing guaranteed excellence in a ⅜" bar from which thousands of miniature milling cutters are made—and equally in a bar from which may be machined the largest broach you care to produce. Sound steels for profit-making tools, in a complete range of grades, shapes and sizes. Let a Vanadium-Alloys' sales engineer consult with you on your needs.

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DIVISIONS: Anchor Drawn Steel Co. • Colonial Steel Co. • Metal Forming Corporation • Pittsburgh Tool Steel Wire Co. • **SUBSIDIARIES:** Vanadium-Alloys Steel Canada Limited • Vanadium-Alloys Steel Societa Italiana Per Azioni • EUROPEAN ASSOCIATES: Societe Commentryenne Des Aciers Fins Vanadium-Alloys (France) • Nazionale Cogne Societa Italiana (Italy)

USE READER SERVICE CARD; INDICATE A-6-195

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high-precision grinding machines with hydraulic automatic infeed for traverse grinding and plunge grinding as standard equipment on all models.

3 types:

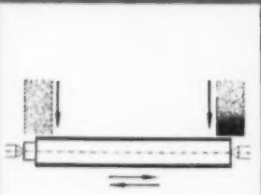
UNIVERSAL. *Swivelling wheelhead, swing-down internal grinding attachment, infinitely variable speed headstock.*

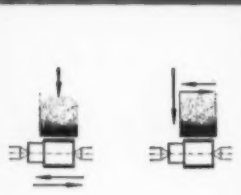
PRODUCTION. *Larger grinding wheel, more horsepower, non-swivelling wheelhead, 8-speed headstock.*

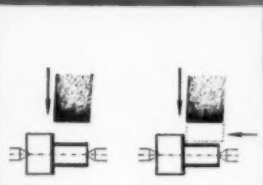
PLUNGE. *Similar to production type but with axially oscillating wheelhead and hand table control only.*

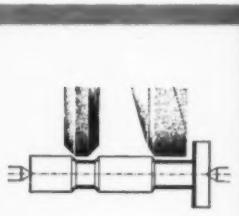
4 sizes:
10", 12", 14", and 18" swings (with choice of lengths between centers).

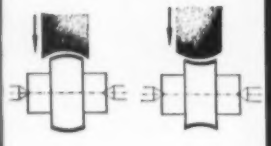
Model R4-500 U shown at left. Universal type, 10" swing, 24" center distance.











SOME STANDARD FEATURES OF OLIVETTI R4 UNIVERSAL GRINDERS:

- *Infinitely variable hydraulically controlled table speeds*
- *Table reversals within ± .0002" as short as 1/16"*
- *Table dwell 0 to 20 seconds*
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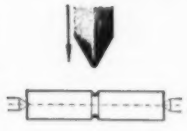
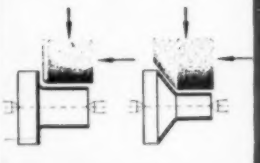
- *Separate automatic plunge feed 0 to .002"/second to positive stop*

For sales, service or information, write Olivetti Corporation of America, Machine Tool Division, 42-33 Northern Boulevard, Long Island City 1, New York Or phone RAvenswood 1-7575.





CHUCKING METHODS CAN BECOME OBSOLETE TOO!

retool with Cushman

AIR OPERATED CHUCKS

Designed and built to fully meet modern machining techniques and machine tool requirements, Cushman Chucks permit the use of higher speeds with heavier feeds, maintaining closer tolerances with continued repetitive accuracy and result in maximum workholding efficiency with the greatest savings in time and costs.

For profitable machining through the use of precision chucking equipment, specify Cushman Air Operated Chucks.

Write for Bulletin PO-66D.

CUSHMAN CHUCKS,
a product of American quality,
labor and materials.

THE CUSHMAN CHUCK COMPANY • HARTFORD 2, CONN.

Sold through your industrial distributor

Now you can do <u>both</u> . . .

SHORT RUNS
LONG RUNS

. . . Drilling and/or Tapping . . .

with ONE adjustable U. S. Drill Head

Complete versatility for job shop operations with standard adjustable arms . . . or, equip these heads with U. S. Slip Spindle Plates which are jig-bored for positive alignment to fit the hole pattern. Eliminates trial-and-error in set up.

Double Duty Tools—when your drilling machine has a reversing spindle, you can drill and tap the same hole pattern with one head.

U. S. Drill Heads are fast and rugged—designed and built for profit-making performance. Positive all-gear drive with shaved gears, anti-friction bearings, and oil-tight housings assure smooth and accurate operation.

Ask for Catalog AD-57, or send specifications of your requirements.

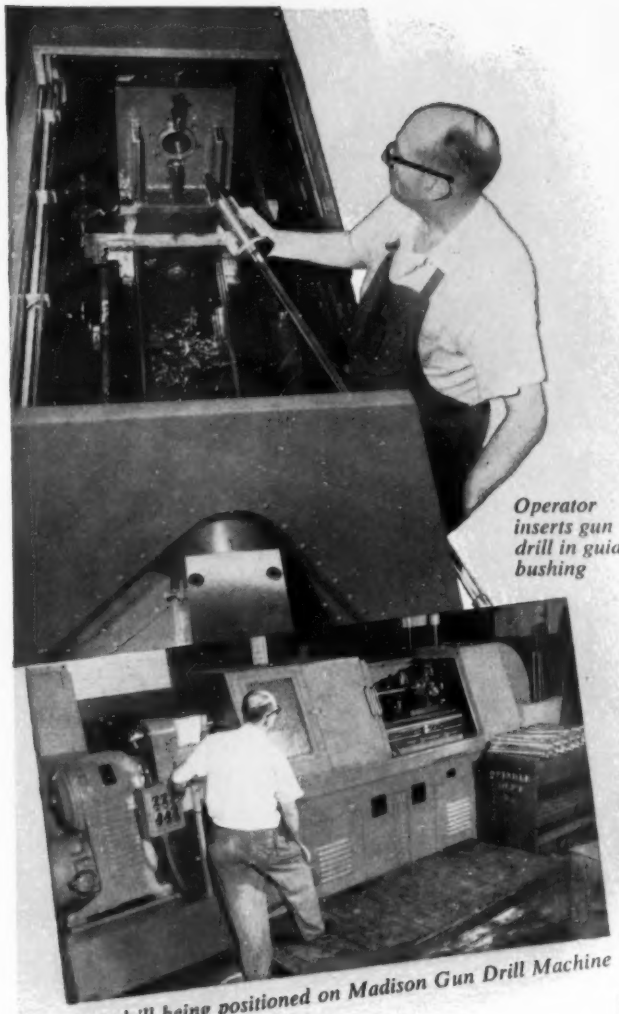
Slip Spindle Plates may be jig-bored for more than one pattern of holes.

US DRILL HEAD

Adjustable and Fixed Center Multiple Drilling Heads.
Individual Lead Screw Multiple Tapping Heads.

UNITED STATES DRILL HEAD CO.

BURNS STREET • CINCINNATI 4, OHIO



Operator inserts gun drill in guide bushing

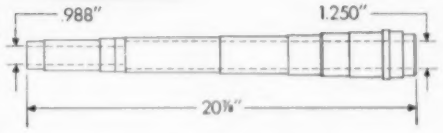
Gun drill being positioned on Madison Gun Drill Machine

AT *Brown & Sharpe*

MADISON

GUN DRILLING TOOLS and TECHNIQUES CUT SPINDLE DRILLING TIME

67%



Brown & Sharpe Spindle
SAE 8615 Steel

In manufacturing spindles for many of their world famous machines, Brown & Sharpe had to produce precision holes ranging from 1 1/16" to 2 13/16", through each spindle.

With an eye on their slogan, *Progress in Precision for over 125 years*, Brown & Sharpe called in their Madison Man. How could these holes be produced better? Cheaper?

Today, Brown & Sharpe with their new Madison gun drilling machine have cut drilling time by 67%, yielding a threefold increase in production.

Madison Gun Drill Method

	Min.
Gun drill .988" through hole	11.50
Gun ream 1.250" to depth	4.25
Handling time	4.00
TOTAL TIME	**19.75 minutes** floor to floor

How about your own plant? You can boost production and precision with Madison Gun Drills and Reamers on your present equipment. HOW? CALL THE MAN WITH THE HOLES IN HIS HEAD . . . YOUR MADISON MAN. HE HAS THE ANSWERS.

FREE!

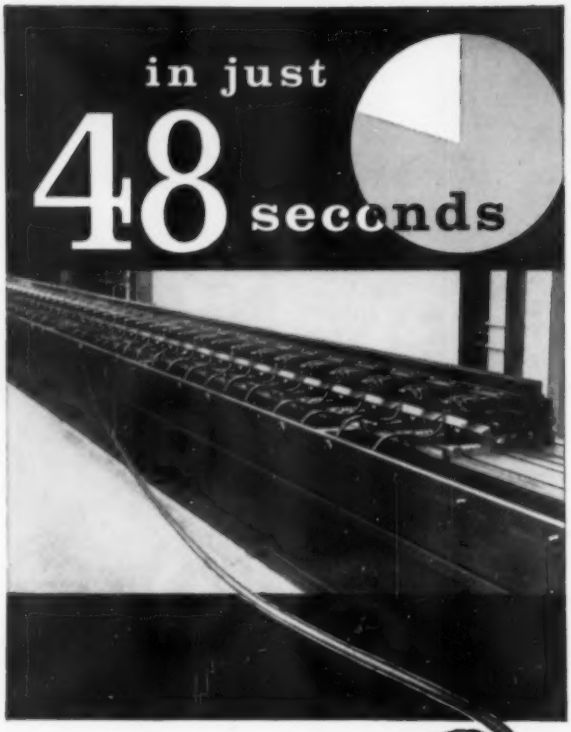
Get your Madison Fact File on Gun Drilling — tips and techniques on how to save money, increase production.

First in inner diameters

MADISON INDUSTRIES, INC.

DEPT. 216 PROVIDENCE 1, RHODE ISLAND

Associated with: Madison-Faessler Tool Co. • Madison-Relco Tool Co.



THIS HAND clamps 96 cylinders from one source

It's a fact! This hand, with one pump activates 96 clamps simultaneously. The Newton Hydraulic Clamping System of pumps, cylinders and mounting parts provides ease of application . . . Cuts production time . . . And is moderate in cost.

Learn more about this universal clamping system. See your Newton distributor now or write for free catalogue, with full scale templates provided.

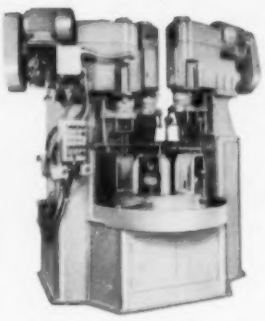
NEWTON HYDRAULIC TOOLING COMPANY

NEWTON

AUBURN, MASSACHUSETTS, U.S.A.

USE READER SERVICE CARD; INDICATE A-6-200-1

NEW KAUFMAN MODEL 10E-1125 TAPPING MACHINE



- For drilling, countersinking and tapping a wide variety of flanged valve bodies.
- Three-head machine provided with 7½ h.p. standard head units, four-spindle adjustable heads and five-division index.
- Head units provided with six-speed transmission, hydraulically operated adjustable feed, rapid advance and adjustable time delay at bottom of stroke.

Kaufman's new Model 10E-1125 handles a large range of flanged bodies with different diameter of drills, countersinks and taps on a variety of bolt circles — for example: four holes are completed in part at one time. Whether you need Model 10E-1125 or a machine with standard drilling or tapping head units, or a machine for a new, unusual job — write or telephone Kaufman today!

KAUFMAN

KAUFMAN MFG. CO.

553 S. 29th Street, Manitowoc, Wisconsin

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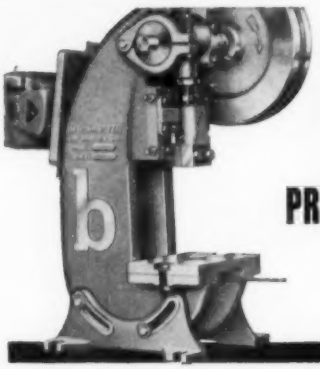

THERE'S A BENCHMASTER FOR EVERY PRESS OPERATION

at ratings from 2 to 10 tons!

Benchmaster gives you a series of proven presses and press designs — backed by 20 years of industrial use — with stock parts and dealers from coast to coast!

Benchmasters are the *accepted* presses — standards of the industry for all light tonnage applications.

Made in 2, 5, 8 and 10 ton capacities in Plain OBI, Back-Geared, Deep Throat, Fixed Bed Gap Frame, Multiple Ram and Half Press models with mechanical, air or electric clutches. Also available: Mechanical 2 hand trip lever or 2 hand solenoid operation for maximum safety.

When you need a press for *any operation*, check with Benchmaster . . . *known for service, for reliability . . . for over-all press versatility, and for low cost!*

benchmaster

World's largest manufacturer of small punch presses and mills.

1835 W. Rosecrans Avenue • Gardena, California

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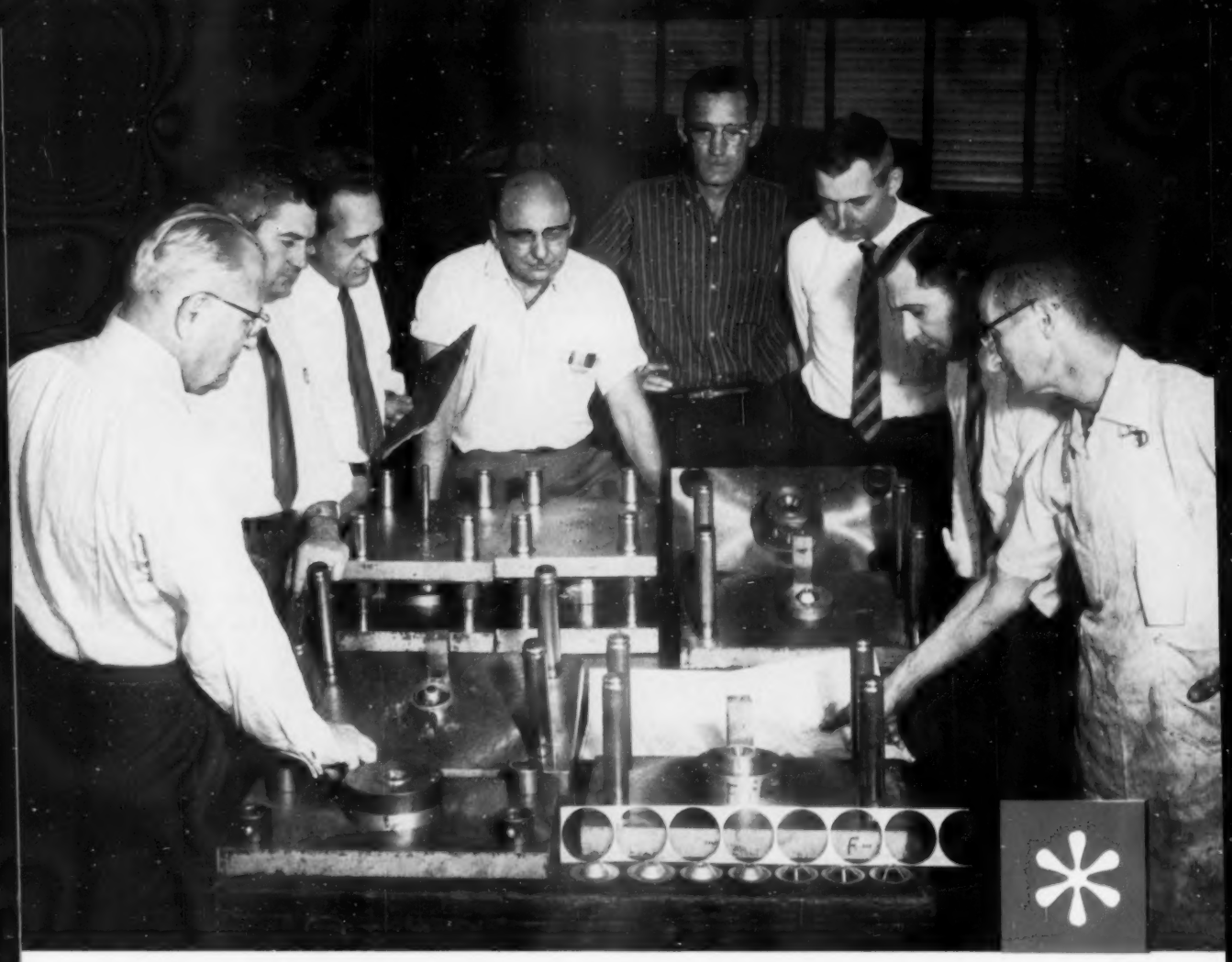


Do you know these tooling specialists?

If you don't, you should. On any tooling problem requiring high-precision gages, dies, jigs, fixtures or special machinery, they can save you time, money, headaches. They can keep you out of production jams... *or pull you out.*

These eight men * represent over 200 years of the choicest, most specialized tool-and-diemaking experience in America. Strong words? Well, consider these facts:

They direct what leading manufacturers in the electrical, appliance, automotive, ordnance and other industries acknowledge is the best-manned, best-equipped toolmaking facility on the Mississippi. Best-manned, because Ehrhardt has over 50 veteran tool-and-die makers and designers, many of them trained here. Best-equipped, because there isn't an important late-model precision machine tool or device (jig borers, jig grinders, profile grinding, electrical discharge equipment, etc.) which you won't find at Ehrhardt.

If you need close-tolerance work—whether it's a gage that takes 40 hours or less to produce or a complex lamination die requiring several thousand hours—you will be doing yourself a favor to get to know these men, to observe their skilled craftsmen and their unparalleled facilities.

You can do this by visiting the Ehrhardt plant, and you are cordially invited to do so. In the meantime, write for a copy of TRIPLE PLUS (the three plusses: "Precision Skills, Full-Range Facilities, Unique Experience"), a twenty-four page illustrated brochure which will convince you why knowing these tooling specialists can be worth your while.

Ehrhardt Tool & Machine Company

914 Monroe Street, St. Louis 6, Mo.

"A Nation-wide Service to the few who want the most in high precision gages, dies and fixtures."

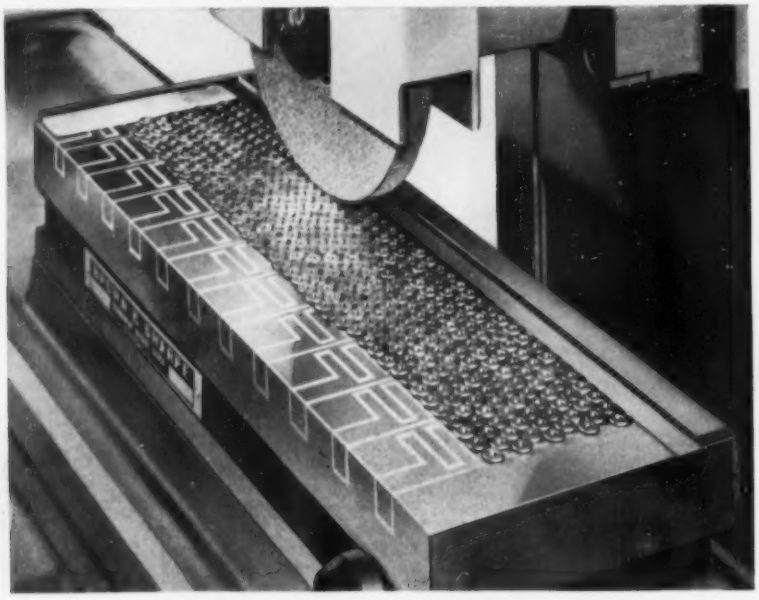
Ehrhardt/St. Louis

EHRHARDT/ST. LOUIS PLANNING COMMITTEE—left to right: Willis G. Ehrhardt, president; Charles Hawkins, general manager; Bill F. Boyd, purchasing agent; Ed Humm, shop superintendent; Ed Deuser, shop foreman; Joe Poletti, chief tool designer; Bud Graser, sales engineer, and Tony Wieclaw, veteran tool and die maker.

USE READER SERVICE CARD; INDICATE A-6-201

Precision Tool News

No. 10 B·S REPORTING NEW DEVELOPMENTS AT BROWN & SHARPE'S PRECISION CENTER



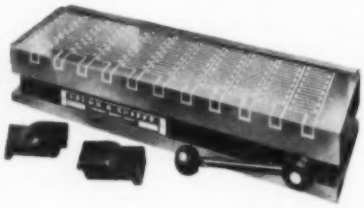
Very small parts or thin strips held tightly and accurately on new B&S Fine Mesh Permanent Magnet Chuck

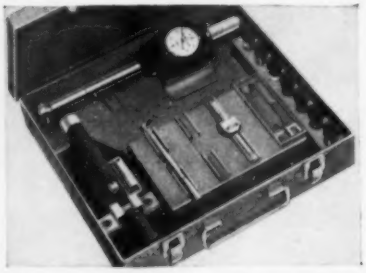
Magnetic poles are closer together on this new Brown & Sharpe chuck than on any other permanent magnet chuck. Closest spacing in the pattern is 3/32", and at no place within the magnetic area are poles more than 3/16" apart. As a result you can hold smaller parts — anywhere inside the area — without worrying about weak spots.

The extra-fine mesh also holds long, thin strips perfectly flat — without the waves that are apt to develop in strips when they're held on chucks with wider pole spacing.

You get exceptional accuracy with this chuck, because of its extra-thick, rigid top plate — that doesn't deflect or sag when the chuck is turned on. And, the thick top plate lasts longer, too — it can be dressed down a full 1/2".

Brown & Sharpe's Fine Mesh Rectangular Permanent Magnet Chuck, No. 618-3, provides a working surface of 6" x 18"; magnetic surface for small, thin parts of 4 3/16" x 16 5/16". For larger, thicker pieces, its magnetic surface is a full 6" x 16 5/16".





New B&S Dial Bore Gage Set Saves Up to 50% Cost Covering 1/8"-1" Range

Interchangeable arbors and measuring heads are used with one basic indicator assembly in the new Brown & Sharpe economy Dial Bore Gage Set. It covers measurements from 1/8" to 1", by .0001" — yet sells for only about $400 — *half* the cost of separate gages for this range. A bore-gage setting device that eliminates the need for setting rings is included.

Oblique Graduations on New B&S Micrometer Prevent .025" Errors

Patented oblique (slanting) graduations on the *barrel* of Brown & Sharpe's Convertible Thimble Micrometer show quickly "where you've been and where you're going." They are still visible when older style straight graduations are hidden. They prevent the unfortunate .025", one-revolution errors that so often occur.

Other features: Thimble converts quickly to either friction or fixed type — floating, thumb-operated lever clamp. Personalized with initials at no extra cost. No. 1011 — Range, 0" to 1", in .0001".

Ask your B&S industrial distributor to show how these new tools can save money or time in your own operation. Brown & Sharpe Mfg. Co., Providence 1, R. I.

Brown & Sharpe

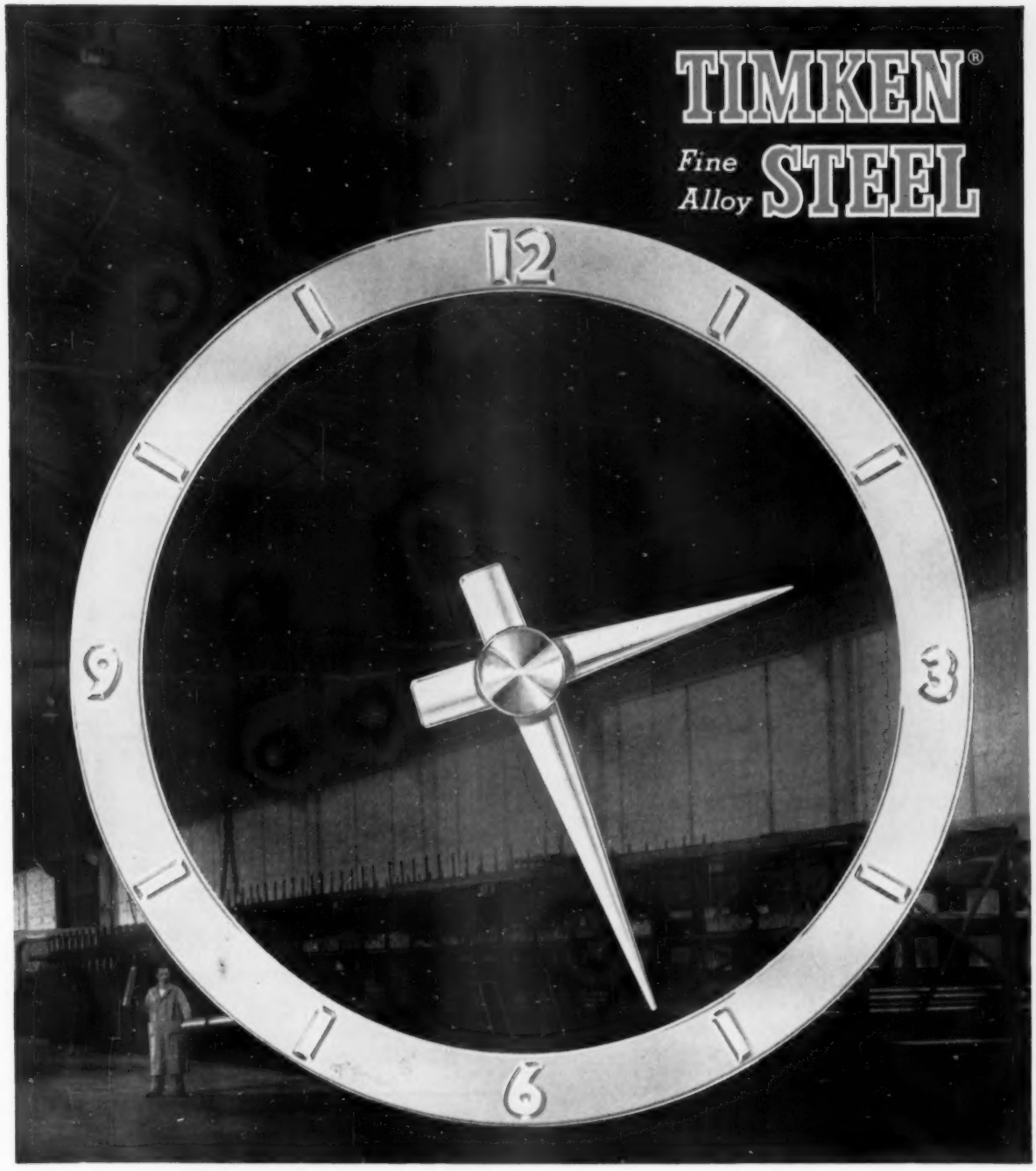
INDUSTRIAL PRODUCTS DIVISION

PRECISION TOOLS AND GAGES
SCREW MACHINE TOOLS
SHOP ACCESSORIES

B·S

PROGRESS IN PRECISION FOR OVER 125 YEARS

INDUSTRIAL DISTRIBUTORS THE RIGHT HAND OF PRODUCTION



ANY TIME is the right time to order Timken® 52100 steel tubing. We'll ship within 24 hours from our new warehouse. 101 sizes of tubing are available, ranging in size from 1″ to 10½″ O.D. with a wide selection of wall thicknesses. It's handy to use when you need less than mill quantities, too! We can also give you extra fast delivery on 50 sizes of 4620 tubing. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. *Makers of Tapered Roller Bearings, Fine Alloy Steels and Removable Rock Bits.*

FOR PRODUCTION ECONOMY . . . FORD TOOLS CUT FASTER, BETTER, LONGER

CARBIDE TOOLS
- HI-ROC DRILLS
- REAMERS
- END MILLS
- CUTTERS
- SPIRAL FLUTE DRILLS
- BORING TOOLS

H.S.S. TOOLS
- CUTTERS
- COUNTERSINKS

H.S.S. and SOLID CARBIDE Ford tools present the economical answer to long-run production problems. By maintaining cutting edges longer, resharpening time is reduced. Tool replacements are minimized.

Ford precision tool design cuts part reject rate, too.

With a full range of sizes, Ford tools are available for all production cutting and drilling jobs.

Factual testimonials from industrial users substantiate their lasting precision quality and steady economy. Your shop, too, can benefit from the production advantages of Ford H.S.S. and SOLID CARBIDE machine tools. Available through all Ford industrial distributors.

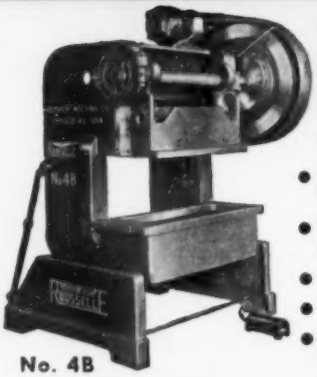
Write Dept. TE-659

Rotary FORD Tools

M. A. FORD MFG. CO., INC.
1545 Rockingham Rd., Davenport, Iowa
Manufacturers of Precision Machine Tools

USE READER SERVICE CARD; INDICATE A-6-204-1

New 40-TON DOUBLE CRANK O.B.I. ROUSSELLE



No. 4B
ROUSSELLE PRESS

WITH NEW ELECTRICALLY CONTROLLED AIR CLUTCH

- "Plug-in" foot and hand controls.
- Single stroke, continuous and jog selector.
- Low air consumption.
- Large die area.
- Roller bearing flywheel.
- Bronze main and crank bearings.

CHOICE OF 30 SIZES AND TYPES IN 5 TO 40-TON PRESSES

SERVICE MACHINE CO.
Mfrs. of Rousselle Presses
2310 WEST 78th STREET • CHICAGO 20, ILLINOIS

ROUSSELLE PRESSES ARE SOLD EXCLUSIVELY THROUGH LEADING MACHINERY DEALERS

USE READER SERVICE CARD; INDICATE A-6-204-2

MARVECO LIVE CENTERS

Guaranteed to outperform and outlast any other LIVE CENTER.

The WHOLE HEAD turns on Double Row Ball Bearings for Radial Load and Tapered Roller Bearings for Thrust Load.

MARVEL TOOL & MACHINE CO.
1086 North River Road • St. Clair, Michigan

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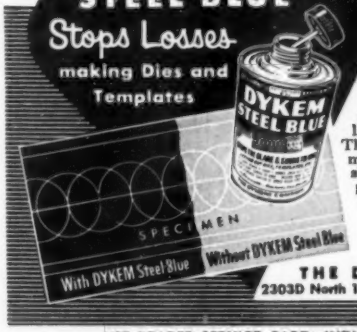
DYKEM STEEL BLUE

Stops Losses making Dies and Templates

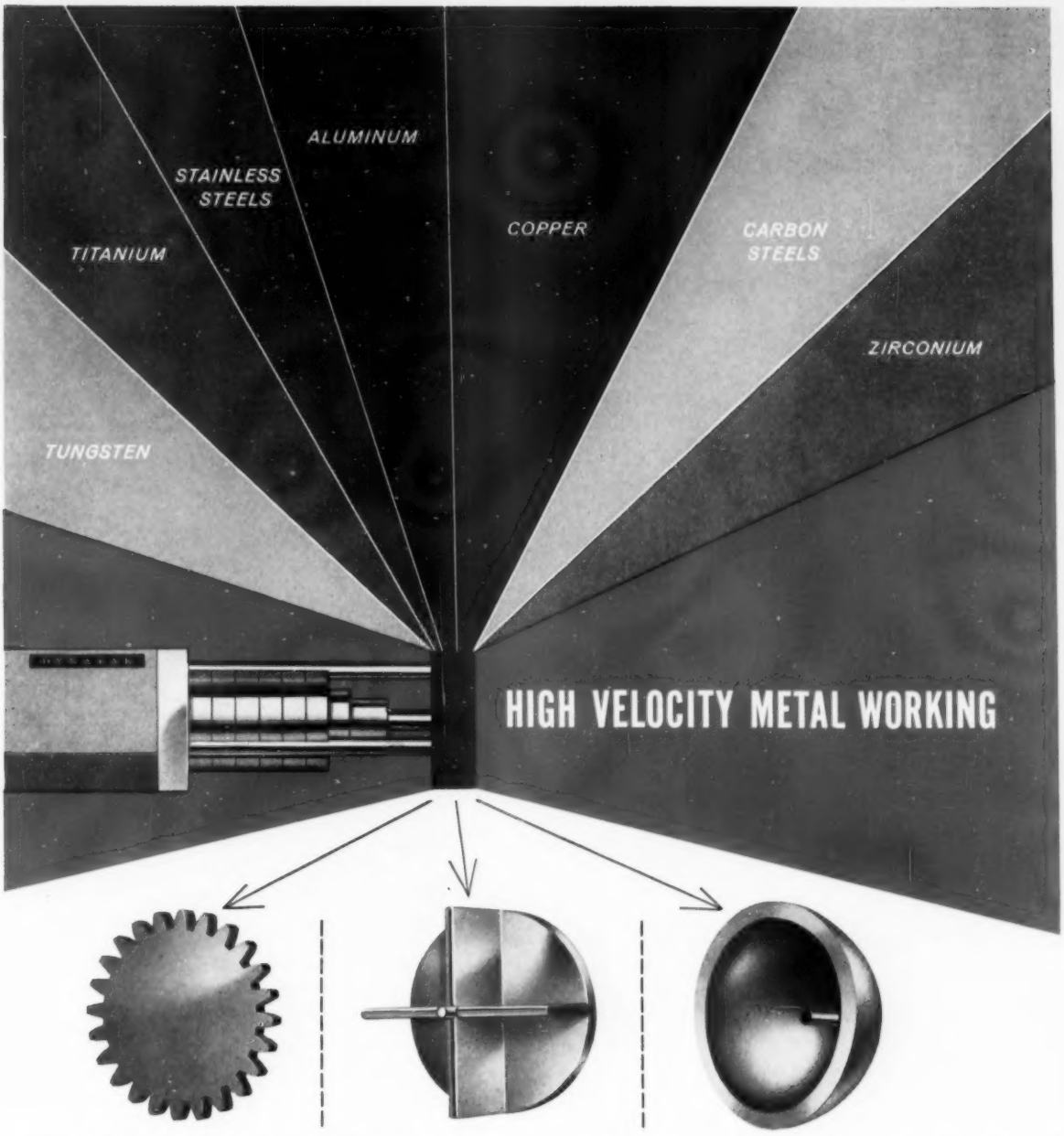


Popular package is 8-oz. can fitted with Bakelite cap holding soft-hair brush for applying right at bench; metal surface ready for layout in a few minutes. The dark blue background makes the scribed lines show up in sharp relief, prevents metal glare. Increases efficiency and accuracy.

Write for sample on company letterhead

THE DYKEM COMPANY
2303D North 11th St. • St. Louis 6, Mo.

USE READER SERVICE CARD; INDICATE A-6-204-4



DYNAPAK—A NEW DIMENSION IN DESIGN AND PRODUCTION OF METAL PARTS

The ability of DYNAPAK high velocity metal working machine tools to forge, form or extrude intricate shapes to precision tolerances from common or high strength metals, offers new solutions for complex problems of design and manufacture.

THE DESIGN ENGINEER will find a new degree of freedom in design. He is no longer confined by the limitations of conventional forming techniques. He can now more nearly specify the ideal materials, shapes, and tolerances.

THE PRODUCTION ENGINEER can often accomplish, in a single operation and with simplified tooling, what would otherwise require multiple operations and complex tooling. With DYNAPAK, management can realize a substantial long-term advantage in capital investment.

Arrange today to evaluate DYNAPAK for your metal working operations. Write, wire or phone

DYNAPAK

CONVAIR / A DIVISION OF GENERAL DYNAMICS CORPORATION

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When you see uniformity, remember...

With Card dies you get uniformity

Your production's consistent ...because Card dies are uniform

. . . And every one is backed by Card Division's *process inspection.* This thorough inspection system starts with the bar stock and is carried through each succeeding step of production . . . machining . . . heat treating . . . finishing. Every dimension is critically checked by men and machines. You get dies that are uniform . . . tools that you can depend on to do their jobs efficiently . . . economically. Your Card technical man has full details on how the high precision of Card dies can improve *your* production picture. S. W. CARD DIVISION, Mansfield, Mass. Card Warehouses: Atlanta, Chicago, Detroit, Fort Worth, Los Angeles, New York, San Francisco.

The CARD Quality

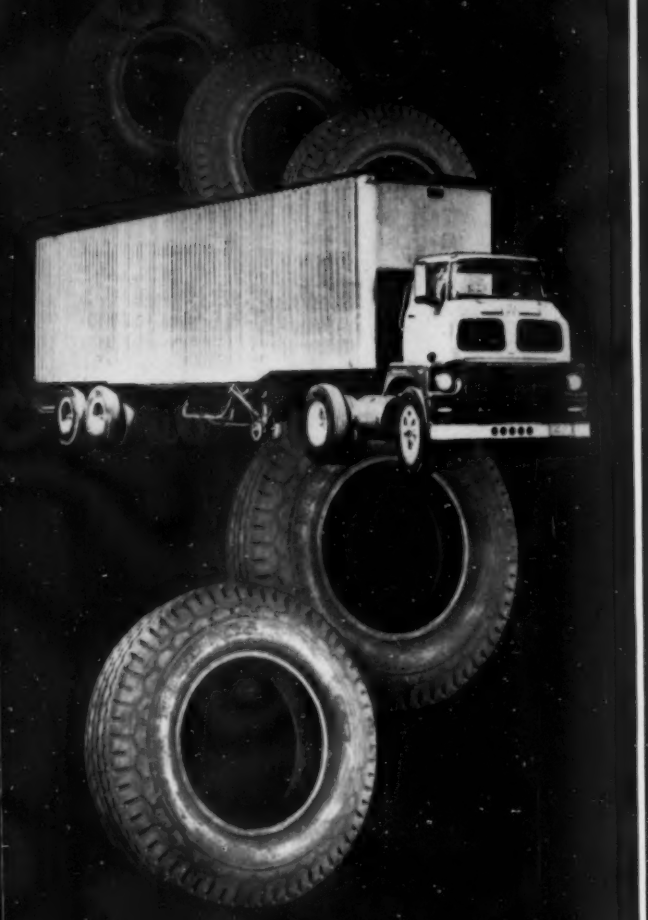
CARD

DIVISION OF UNION TWIST DRILL COMPANY

— Serving you through the best distributors from Coast to Coast

USE READER SERVICE CARD; INDICATE A-6-206

If you use drills as much as trucks use tires...



Ordering Union drills will cut your production time and costs

The more you use drills the more you need Union

Union drills are made in every type and size you need, with every advantage you need — in materials, design, workmanship and performance — to save you time and money on every drilling job. In your plant, as in plants throughout the country, a Union technical man will be glad to prove that production time and costs can be cut with Union drills, end mills, milling cutters, gear cutters, reamers, hobs, carbide tools and inserted blade cutters. **Available nationally through Union Distributors.** Full stocks are maintained in Atlanta, Chicago, Detroit, Fort Worth, Los Angeles, New York City and San Francisco.

UTD

UNION

TWIST DRILL COMPANY, Athol, Massachusetts

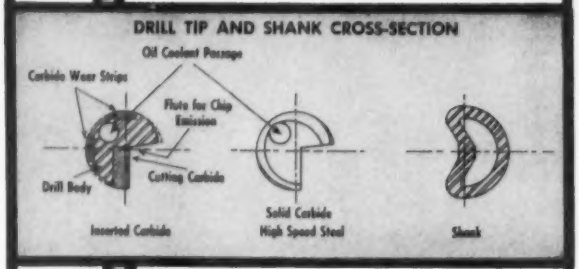
S. W. CARD DIVISION, Mansfield, Mass., BUTTERFIELD DIVISION, Derby Line, Vt.

USE READER SERVICE CARD; INDICATE A-6-207

THIS DRILL ELIMINATES SECONDARY OPERATIONS

Just *one* pass with these high-speed steel or carbide-tipped gun drills produces an accurate, truly round, straight hole honed to mirror-bright finish. That's why you can drill small parts of all kinds — *faster, more accurately* and at *lower cost* with HI-STANDARD Gun Drills*.

Production parts that once had to be drilled individually can now be gang-nested and drilled through, producing holes identical in size, location and finish. Drilling of this kind is done on automatic indexing machines, lathes, horizontal and upright drilling machines, and similar equipment. Forced oil feed through the drill clears chips and cools cutting edge for faster drilling. No matter what the size or shape of your workpiece, drilling with HI-STANDARD Gun Drills is an



outstanding time-and-money saver. Any material that can be *machined*, can be *gun-drilled*.

Gun drilling is one important way in which forward-thinking manufacturers are increasing production and cutting costs. To find out how your company can do the same, write for your Hi-Standard Engineering File 20 *today!*

*Also called "deep-hole drills"

Pioneers in the Design and Development of Gun Drills for more than 30 Years

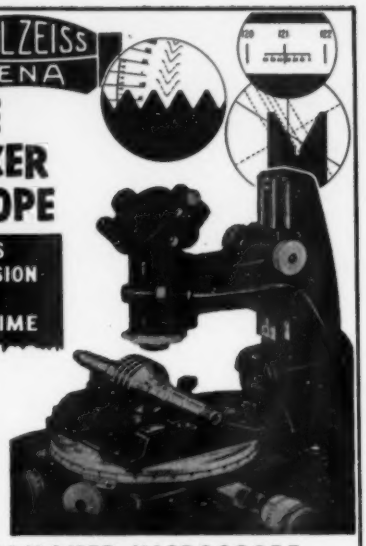
THE HIGH STANDARD MANUFACTURING CORP.
HAMDEN • CONNECTICUT

USE READER SERVICE CARD; INDICATE A-6-208-1

NEW CARL ZEISS JENA

LARGE TOOLMAKER MICROSCOPE

...PRODUCES HIGHEST PRECISION
....CUTS INSPECTION TIME



At Last...
available again the ORIGINAL
CARL ZEISS JENA

New Type
LARGE TOOLMAKER MICROSCOPE

. . . **actually measures** (not only compares drawings or shadows) any type of work for shape, angles in degrees and minutes, radii, distances between holes, tapers, spacings, width of keyways and splines, graduations, thread check for angle of flank in minutes, lead and pitch errors of taps, chasers, hobs, cutters and other irregular work **which cannot be checked in any other way.**

RANGE: 6" x 2" — BUILT-IN ROTARY TABLE (11" Diameter) thru 360°

GET THE FULL STORY OF THE VERSATILITY OF THIS OUTSTANDING SHOP AID — Request Circular

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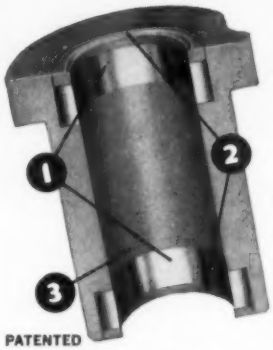
USE READER SERVICE CARD; INDICATE A-6-208-2

Does the Job of Solid Carbide ...COSTS LESS!



PATENTED

1. Tungsten carbide rings at the points of wear; 2. Steel rings protect drills and carbide; 3. Special hardened alloy steel body.

There in a nut shell is the story of MEYCO carbide inserted drill jig bushings! Does everything a solid carbide bushing will do at less cost: lasts almost as long; increases life of drills and jigs; greater accuracy—longer; saves man-hours and machine down-time! All this spells high production at a lower cost. For over a decade, carbide inserted drill jig bushings have been saving money on long production runs for cost conscious customers.

Write for full details—
ask for new Bushing Catalog No. 42

W. F. MEYERS CO., INC., BEDFORD, IND.

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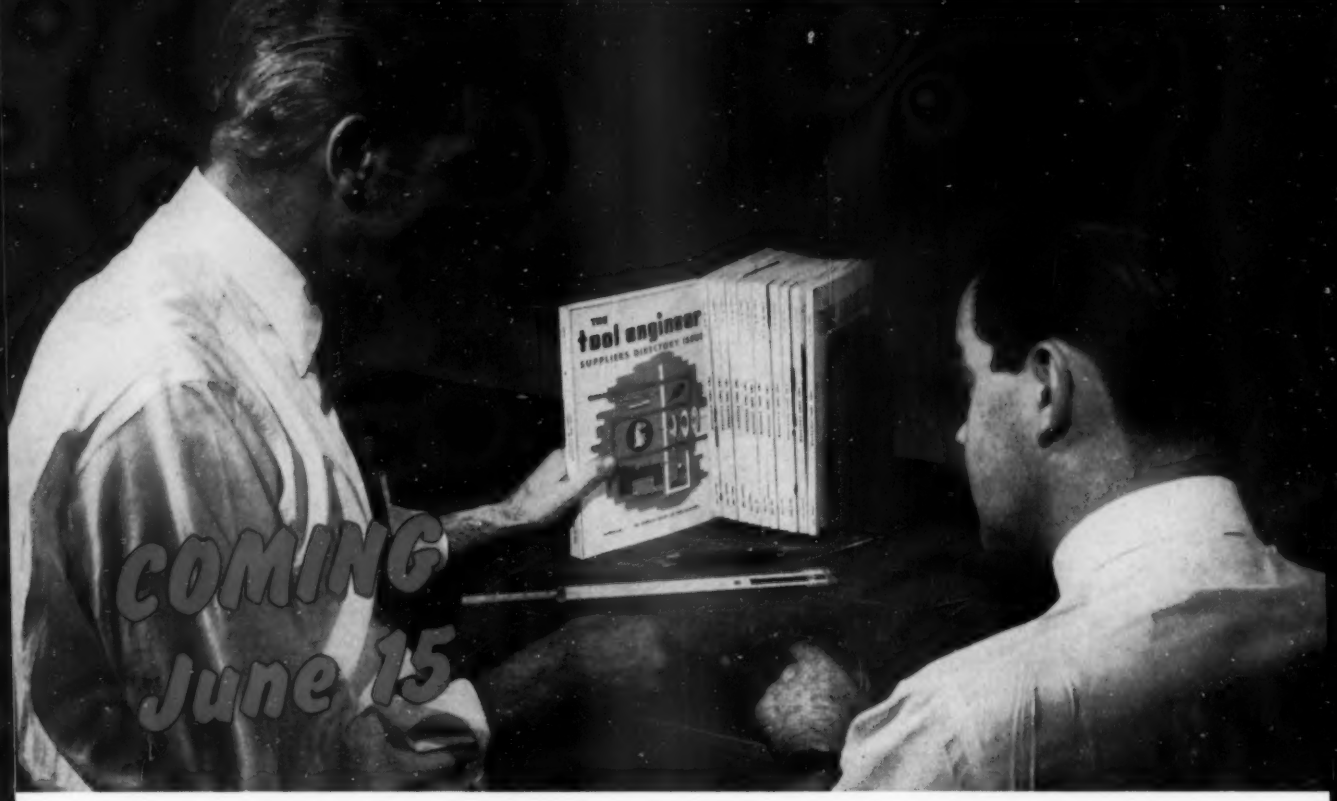
ANOTHER MEMBER-SERVICE BY ASTE



THE TOOL ENGINEER Suppliers Directory Issue— a thirteenth issue of THE TOOL ENGINEER

WITH THE PRODUCT INFORMATION SERVICE YOU ASKED FOR!

EVERYTHING YOU NEED— IN ONE CONVENIENT SOURCE

Locate the product—*fast*
Products Section contains 1,000 classified product headings, plus 15,000 manufacturers' listings.

Locate the supplier—*fast*
Manufacturers Section lists 2,500 manufacturers, with home office addresses and 45,000 coded sales office listings.

Locate the closest source—*fast*
Sales Office Section contains addresses and phone numbers of more than 18,000 manufacturers' agents, distributors and sales offices, arranged by state and city.

The 13th issue of THE TOOL ENGINEER is reader-engineered to give you the local source for over 1,000 metalworking products.

The information contained in the Directory Issue was supplied by over 2,500 manufacturers and is authoritative and up-to-date. It will be the first Directory Issue of its kind—tailored for quick use. It is organized alphabetically, cross-referenced and indexed to insure constant and easy use.

The manufacturers' sales and service outlets in your area will be at your finger-tips to give you immediate assistance to your everyday tool engineering problems.

In addition to this time-saving information, you will find helpful engineering articles prepared by the editors of THE TOOL ENGINEER.

THE TOOL ENGINEER Suppliers Directory Issue is the thirteenth issue of THE TOOL ENGINEER and will be included as a regular issue in the basic subscription price to ASTE members and non-members.

ASTE

THE TOOL ENGINEER Suppliers Directory Issue

Publication Date: June 15, 1959

THE AMERICAN SOCIETY OF TOOL ENGINEERS

why **BAIRD** **CHUCKERS** give you a

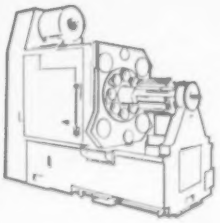
Production bonus

Fully-Loaded, Job-Mated Work Stations

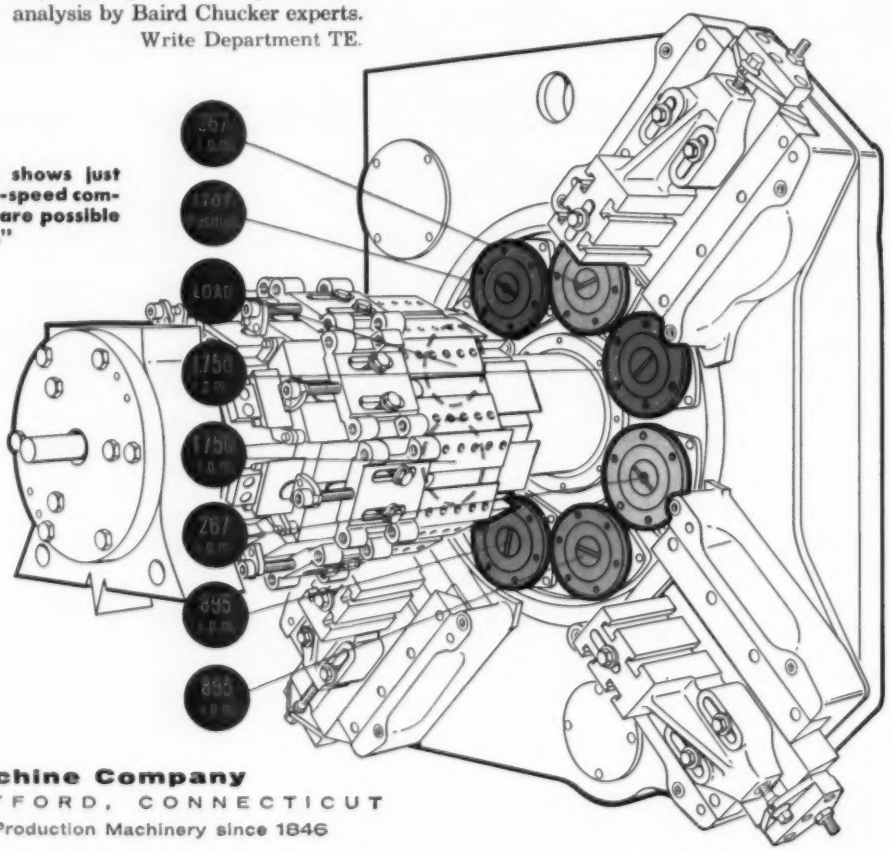
Here is an *exclusive* Baird Chucker feature that can make a tremendous difference in the *quality* of the work produced, as well as in the production rate. Only Baird offers a selection of individual work station spindle-speeds, in the same cycle, on the same set-up. Possible spindle-speed combinations are in the range from 33 r.p.m. to 1750 r.p.m. Within broad limits, any desired grouping of up to three individual spindle-speeds can be provided in a given set-up. Individual spindles may also be stopped and accurately positioned for multiple head drilling or similar operations.

This means that the operations to be completed at each individual station can have feeds and speeds set up for maximum production efficiency, as well as for the optimum feed and speed conditions required for precision tolerances and surface finish.

Only Baird Chuckers . . . designed and built for high, close-tolerance production . . . offer you this important feature. Available in 6-spindle and 8-spindle models. Outline your program . . . for production analysis by Baird Chucker experts.
Write Department TE.



This sectional close-up shows just one example of spindle-speed combinations. Many others are possible . . . "Ask Baird about it."



The Baird Machine Company
STRATFORD, CONNECTICUT
Builders of High Production Machinery since 1846

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save machining costs with this versatile new tool

only $565
BASIC UNIT
F.O.B. RACINE

DUMORE VERSA-MIL®

MILLS · BORES · SHAPES
SLOTS · GRINDS · DRILLS

... anywhere!

● Compact, rigid, portable, this *new* machine efficiently performs in any position, as an independent unit with its own power and feeds, or added to machine tools—lathes, planers, shapers, millers, grinders. Saves handling, moving, set-up and down time.

Gives close tolerance, quality results while removing metal at *profitable* rates. Adapts quickly to standard machines, fixed machinery in place, pieces in fixtured set-ups, or on parts too big for standard machines. By taking Dumore Versa-Mil to the work, it gives you the advantage of machining where it is most economical!

For Maintenance, Job Shop, Tool Room and Production Uses

GET THE FACTS . . . SEND COUPON

You Can Do More with DUMORE®

All-Purpose Precision Metalworking Tools

THE DUMORE COMPANY • 1310 Seventeenth Street, Racine, Wisconsin

Versa-Mil • Drill-N-Tap Units • Drilling Units • Drill Heads • Micro-Drills • Drill Grinders • Precision Grinders • Hand Grinders • Flex-Shaft Tools • Quills and Accessories

MOUNTS ON ANY MACHINE TOOL

Milling 5" Keyway on a Planer

Slotting 42"-Long on a Lathe

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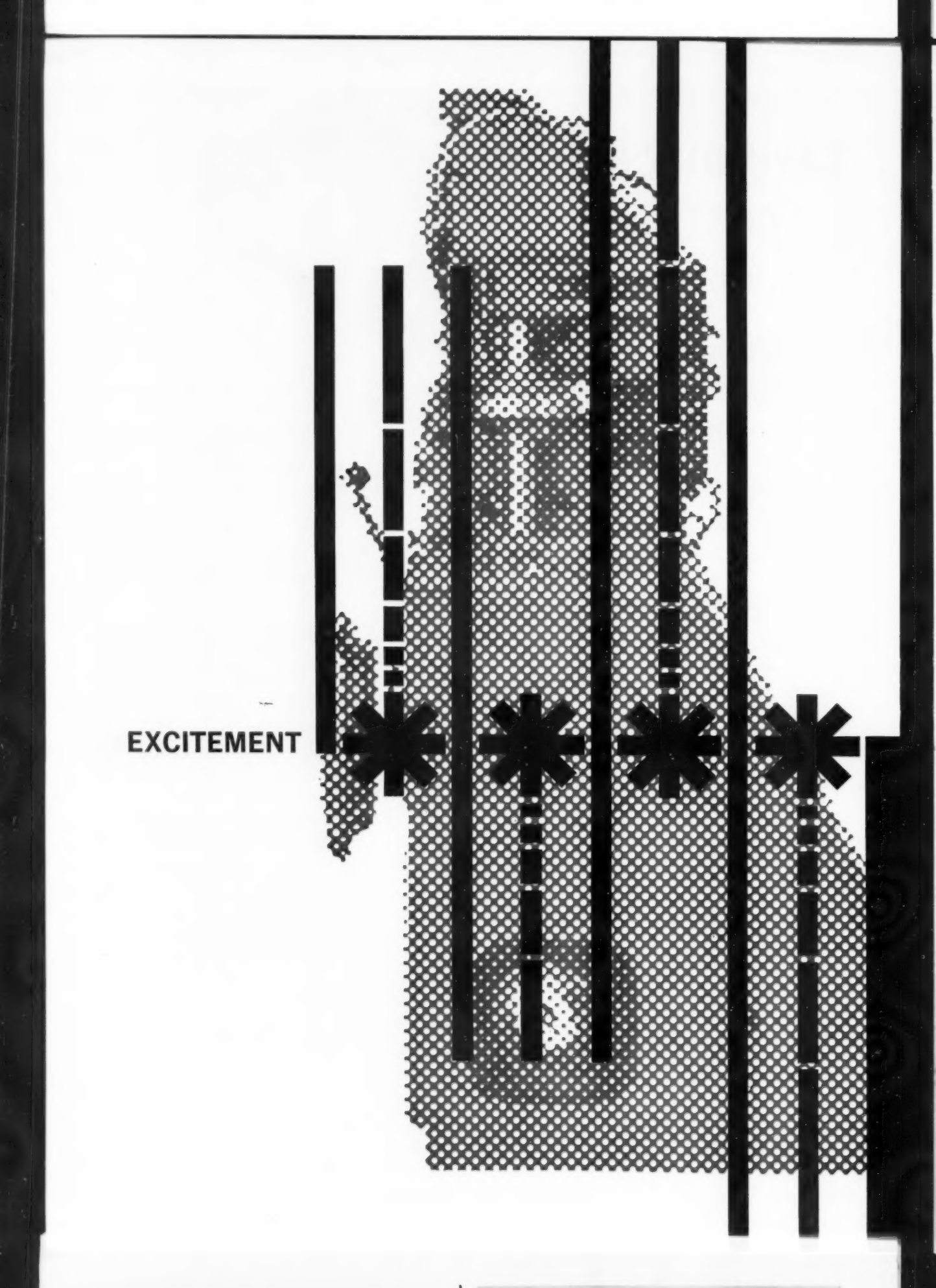
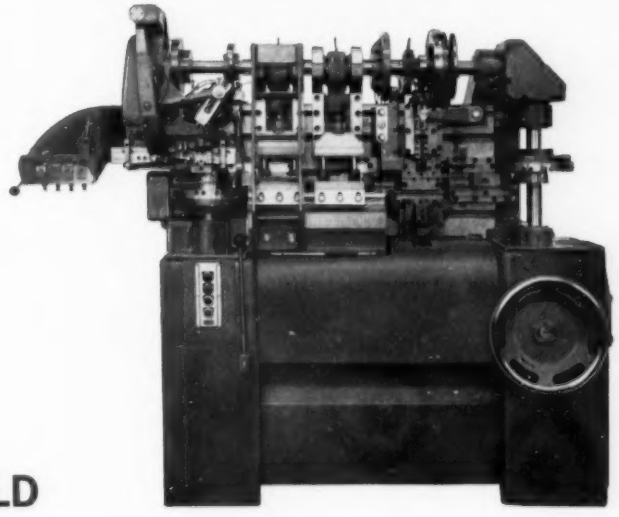

EXCITEMENT

Once in a blue moon, a really exciting new production machine is developed . . . and this is it!

It's the Torrington **Verti-Slide** which promises a genuine revolution in the production of just about everything in strip forming that is now being produced by progressively tooled presses.

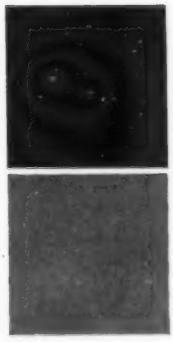
Single-handed, the Torrington **Verti-Slide** has already demonstrated its ability to replace as many as six presses in high speed precision production of complex parts.

Cooler heads than ours are telling **us** that it's the most exciting new development in its field in half a century.



IN THE PRODUCTION WORLD

Write or call today for complete data—or a Torrington sales engineer.



THE TORRINGTON MANUFACTURING COMPANY
TORRINGTON, CONNECTICUT · VAN NUYS, CALIFORNIA · OAKVILLE, ONTARIO

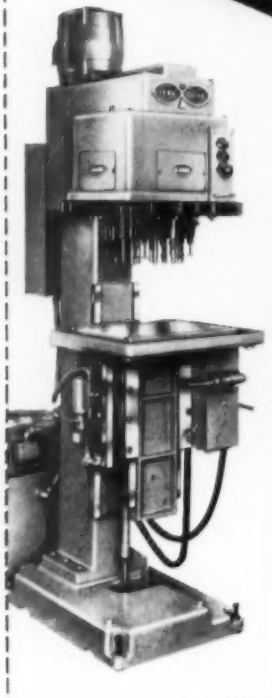
the NEW sensation of the machine tool industry!

PRECISION'S

DEKA® DRILL

MULTIPLE SPINDLE DRILLING AND TAPPING MACHINE

. . . save 50% on capital outlay costs!



Top Performance

- Fully automatic drilling or tapping cycle with push button controls! Up to 14 spindles available!
- Eliminates costly set-ups — makes production runs of 250 pieces profitable!
- Drills or taps 40,000 holes per hour — floor to floor time!

Outstanding Features

RUGGED CONSTRUCTION of Deka-Drill features heavily ribbed castings — will give years of trouble-free service.

HEAVY-DUTY HYDRAULIC MECHANISM is capable of delivering over *two tons* pressure to the ram-type table!

HYDRAULIC LIFT — a *Deka-Drill exclusive*—easily positions the knee and table over a full 14 inches!

HYDRAULIC MODEL H712

$3545.75

with motor and controls F.O.B. Factory

DEALERS: A FEW TERRITORIES STILL OPEN. WRITE FOR DETAILS.

MANUAL MODEL M712 **$1998.50** with motor and controls F.O.B. Factory

PRECISION TOOL & MFG. CO. of ILLINOIS
Dept. TE69
1305 S. Laramie Avenue
Cicero 50, Illinois

Please send me full information on Deka-Drill.

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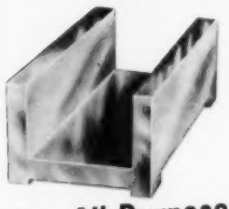
ADDRESS_____

CITY_____ ZONE____ STATE_____

USE READER SERVICE CARD; INDICATE A-6-214-1

You've never seen a body like this before!



the All-Purpose

SMITH

STANDARD JIG AND FIXTURE BODIES

Save 50% in tool design and tool room costs by incorporating these bodies in your jig and fixture designs—for drill jigs, milling fixtures and all kinds of production tooling.

- **Over 65,000 sizes (Special sizes by order)**
- **Made in cast iron and aluminum**

Send for free catalogs today

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ANOTHER SERVICE to ASTE Members

Everyone who subscribes to THE TOOL ENGINEER can look forward to receiving a very special bonus issue on June 15, 1959. The SUPPLIERS DIRECTORY ISSUE will present the industry's most complete and up-to-date guide to product information sources available anywhere. Whenever a tool engineer needs to know more about the specifications, prices, availability or functions of a given product, the SUPPLIERS DIRECTORY will guide him to the nearest *local* source of such information. As an issue of THE TOOL ENGINEER, the Directory will not be lacking in technical editorial content. Articles are planned to include such topics as Cost Estimating and Numerical Coding of engineering products. And, all of this will be provided at no additional cost.

"These 'super-speed' inclinables give me twice the production . . . at about half the cost!"

From their special vibration-absorbing legs to their counterbalanced shafts, these presses are built for speed.

With such special features as bronze gibs . . . automatic lube systems . . . special clutches, brakes and flywheels, and equipped with precision feeds, they can knock out short stroke work at better than 500 strokes a minute! They're all new, all Bliss, and the cost is low—surprisingly so.

These are the latest members of Bliss' line—the line that offers industry its most complete choice of types and sizes. And with no axe to grind for any one type, you can be sure of impartial pressroom counsel—by Bliss.

BLISS SINCE 1857 ®

E. W. BLISS COMPANY · Canton, Ohio

100 years of making metal work for mankind

PRESSES • ROLLING MILLS • ROLLS • DIE SETS • CAN MACHINERY • CONTRACT MFG.

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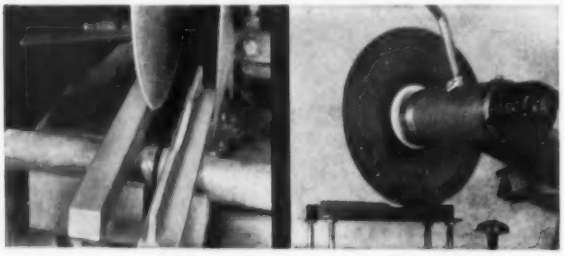
THIS IS ABRASIVE

CUT MACHINING

Straight cuts in a few seconds. *Two* ends machined smooth as each cut is made. In many cases no further machining is needed. Figure your savings!

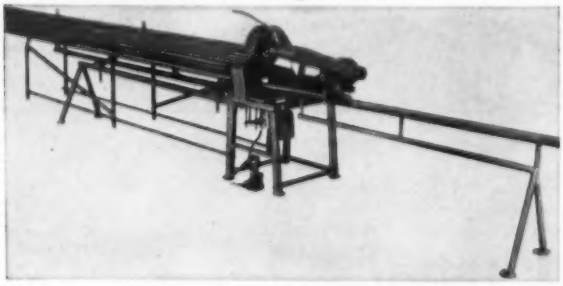
THE WALLACE WAY

Supporting and clamping the material on *both* sides of the cut (left photo, below) assures smooth, precision results in straight or mitered cuts. Wallace mounts the abrasive cutting wheel on a precision-ground, massively proportioned spindle (right photo) that stays accurate under conditions far more severe than normal service brings.



THIS DOES IT

This typical Wallace MODULAR Unit cut-machines tubing up to 6" O.D., solids up to 4". Six additional types of cut-machining units in the Wallace line for larger work, smaller work, automatic and manual operation.



GET THE CUT-MACHINING BOOK

'PHONE Joe Wheeler, **COLLECT** . . . at Wallace's Chicago number:

BUckingham 1-7000

Tell Joe Wheeler where to send your copy. Ask for other cutting help you need. We pay for the call. 'Phone now.

MAIL your request, if you prefer. The CUT-MACHINING BOOK will go promptly to the address you give. Write

Facts you need free of charge

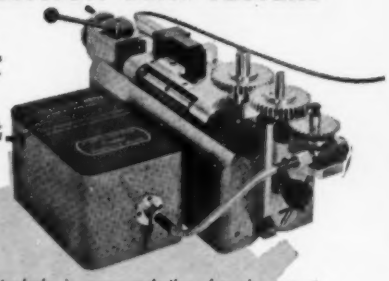
WALLACE SUPPLIES MFG. CO.
1304 W. Wolfram Street • Chicago 13, Illinois

USE READER SERVICE CARD; INDICATE A-6-216-1

GOULDER PRECISION GEAR TESTERS

NO. 1 ROLLING GEAR TESTER

- Capacity up to 4 in. centers. Suitable for gears from 20 D. P. to 150 D. P. between .250 in. and 5 in. diameter.
- Designed specially for gears used in high accuracy radar and similar equipment.
- All types of shafts, gears, bevels, worms, racks, internals, etc. are covered by a wide range of attachments. Vertical Adjustment.
- Power operation and recording available.



Increased engineering standards in gear production demands more precise methods of gear checking. This need is answered by Goulder precision gear testers. Careful selection of materials and rigorous inspection, guarantee retention of the initial high accuracy of these testers. All castings are of Meehanite metal, artificially aged to reduce any possible distortion and ensure stability.

The No. 1 and No. 2 (not shown) Rolling Gear Testing Machines can be supplied with Taylor, Taylor & Hobson electrical recorders. Magnification ranges between 100X and 5000X, obtainable by merely turning a switch. Cabinets can be supplied to house the recording equipment and amplifier.

Specifications for the No. 2 Rolling Gear Tester (not shown) include: Capacity up to 9 in. (or 12 in. in special cases) centers. Suitable for gears from 4 D. P. to 40 D. P. between 1 in. and 14 in. diameter; especially suitable for automobile, aircraft, machine tool and similar applications; versatile layout including unique hollow quill enables the most awkward gear to be handled efficiently. Vertical adjustment.

A Complete Line of Goulder Precision Rolling Gear Testers are available thru Sykes—exclusive U.S. Agents.

SYKES

For Detailed Information and Specifications, Write to:

SYKES MACHINE & GEAR CORP.
744 BROAD STREET • NEWARK 2, NEW JERSEY
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USE READER SERVICE CARD; INDICATE A-6-216-2

Do your machine operators have this EXACT KNOWLEDGE?

With COMTORPLUG they read hole size to a fraction of a "tenth"

Thereby they can exert timely control over their machines to —

- eliminate rejects.
- improve quality.
- increase production.

The *cost is reasonable*, making it practical to equip everyone who needs the EXACT KNOWLEDGE of automatic 2-point gaging of precision bores: showing diameter, tapers, ovality, barrel shape, etc.

for holes 1/8" to 10" diameter

USERS LIKE THESE DEPEND ON COMTORPLUG

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Chrysler Corp.	Division	Scintilla Magneto
Continental Motors	Harris Seybold Co.	Steel Products Eng.
Curtiss-Wright	Homelite Corp.	Studebaker-Packard
Dana Corporation	Int. Harvester Co.	Sylvania (Atomic Div.)
Detroit Transmission	Jacobs Mfg.	United Airlines
Douglas Aircraft		Warner Gear Div.

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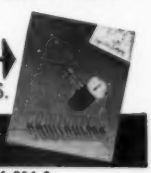

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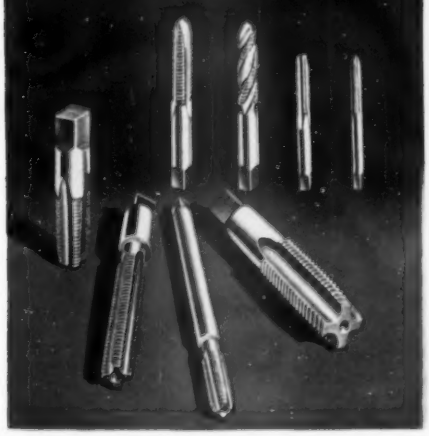

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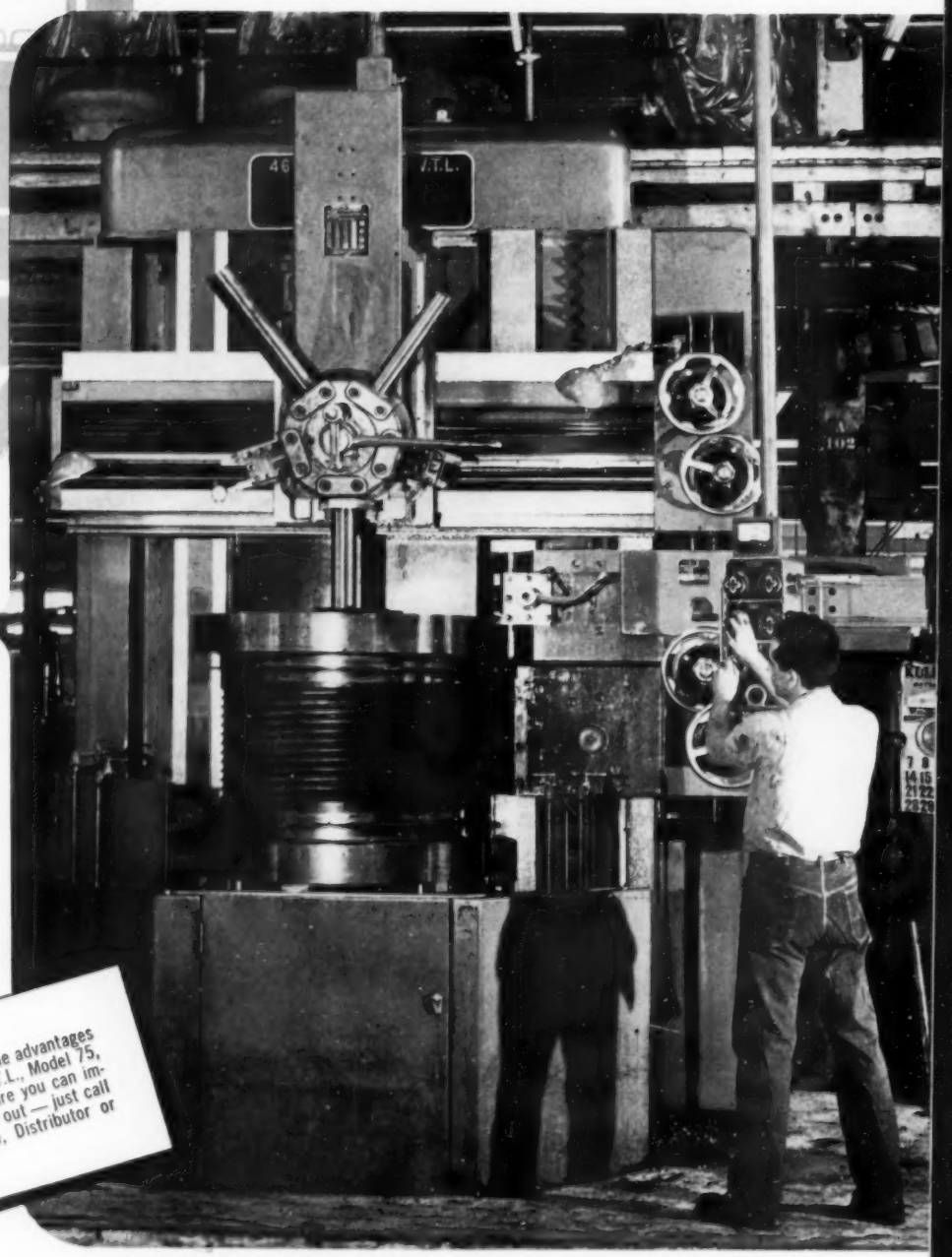

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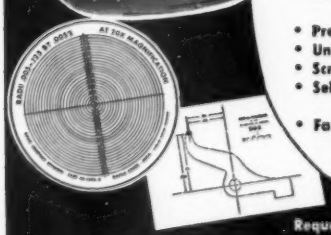

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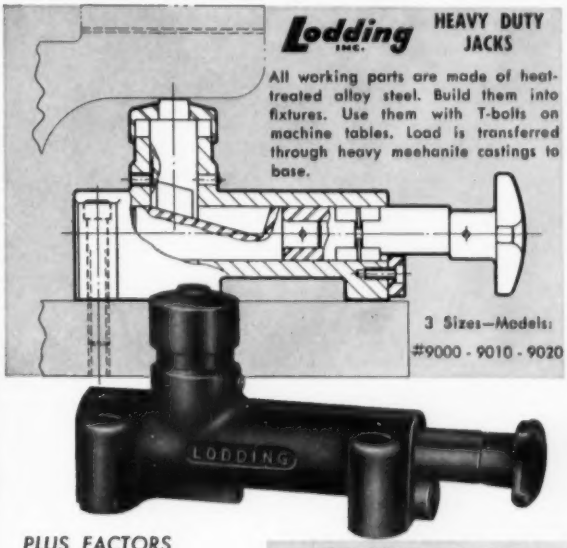
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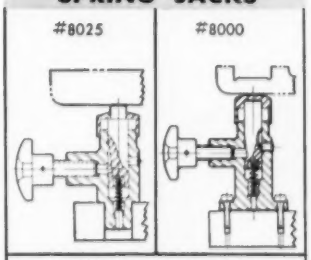

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Officially known as *Diamond Dressing Tools, B67.1-1958*, the new standard is the result of a six-year cooperative effort by ASTE and the Industrial Diamond Asociation of America. Nomenclature has been approved by the American Standards Association. Copies distributed to foreign standards bodies have received world-wide acceptance.

DIAMOND DRESSING TOOLS is available at $1.00 per copy. Please address orders and remittance to Standards Dept. SP-11, AMERICAN SOCIETY OF TOOL ENGINEERS, 10700 Puritan Avenue, Detroit 38, Michigan.

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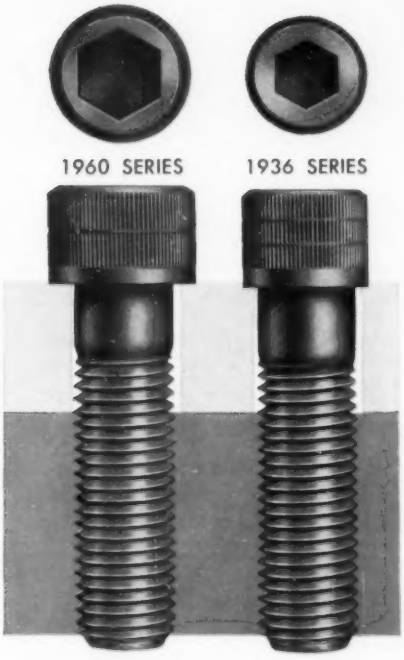
Allen's *New '60 Series* Socket Head Cap Screws



give up to 2⅓ times more load carrying capacity ...without indentation!

In Allen's new '60 Series, head diameter of sizes from ¼" up is now uniformly one and one-half times the body diameter. In many sizes (where this ratio was not called for by 1936 Series specifications) this will provide *more* under-the-head bearing surface, and a proportionate *increase* in clamping force. Loads are more evenly distributed, and the greater bearing area in many cases eliminates need for washers.

Socket sizes have been increased in many cases—greater wrenching area permits higher tightening torque—which resists fatigue failure, and lengthens the life of the threaded joint.

- A new 2-band knurl will identify all ALLEN Cap Screws (except Stainless Steel) that conform to the new '60 Series specifications. New labels on boxes will also identify these.
- The 1936 Series of Allen Cap Screws will continue to be available.

COMPARISON OF ALLEN 1960 SERIES AND 1936 SERIES SOCKET HEAD CAP SCREWS

SCREW SIZE	HEAD DIAMETER Minimum (inches)		BEARING SURFACE Minimum (square inches)		PERCENT OF INCREASE IN BEARING SURFACE[1]	TENSILE LOAD TO INDENT IN SOFT STEEL[2] (lbs.)		TORQUE INDUCED TENSILE LOAD TO INDENT IN SOFT STEEL[2] (lbs.)	
	1960 Series	1936 Series	1960 Series	1936 Series		1960 Series	1936 Series	1960 Series	1936 Series
¼	.365	.367	.044	.044	—	4,750	4,750	2,780	2,780
5/16	.457	.429	.070	.052	33	7,440	5,600	4,380	3,300
⅜	.550	.553	.111	.111	—	12,100	12,100	7,000	7,000
7/16	.642	.615	.140	.103	36	15,000	11,000	8,850	6,450
½	.735	.739	.183	.183	—	19,500	19,500	11,500	11,500
9/16	.921	.863	.293	.216	35	31,000	23,200	18,500	13,600
⅝	1.107	.987	.424	.224	89	45,000	24,000	26,700	14,100
¾	1.293	1.111	.585	.253	131	62,500	27,000	36,800	15,900
1	1.479	1.297	.768	.405	89	82,000	43,500	48,500	25,500

[1]Head tolerance revisions on Sizes #0 thru #10, ¼, 5/16, and ½ diameter have no significant effect on bearing surface or holding power of screws.

[2]Values based on .00025 inch indentation.

Ask your Industrial Distributor about ALLEN '60 Series Cap Screws. Write for samples and complete specifications. Ask for Bulletin G-25.

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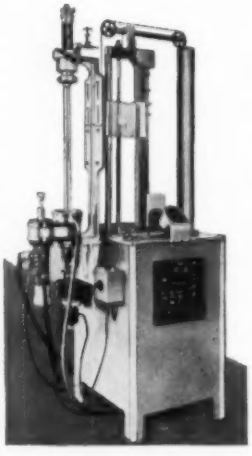
A new floating zone fixture for the production of ultra-high purity metals and semi-conductor materials. Purification or crystal growing is achieved by traversing a narrow molten zone along the length of the process bar while it is being supported vertically in vacuum or inert gas. Designed primarily for production purposes, Model HCP also provides great flexibility for laboratory studies.

Features

- A smooth, positive mechanical drive system with continuously variable up, down and rotational speeds, all independently controlled.
- An arrangement to rapidly center the process bar within a straight walled quartz tube supported between gas-tight, water-cooled end plates. Placement of the quartz tube is rather simple and adapters can be used to accomodate larger diameter tubes for larger process bars.
- Continuous water cooling for the outside of the quartz tube during operation.
- Assembly and dis-assemby of this system including removal of the completed process bar is simple and rapid.



Model HCP

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. . . featuring primary and automatic secondary clutches for driving either self-tapping or regular inserts.

Drives inserts to a very accurate position. Selective position is accomplished by a wide-range depth gage on the driver while driver is rotating. Depth gage is ball bearing mounted, eliminating marking of casting face. "TitanSert" has a primary clutch for driving and a secondary positive clutch for reversing out of insert after it is driven. When insert is driven to proper position, the primary (drive) clutch disengages. When the motive power is pulled back to actuate the automatic reverse, the secondary clutch engages and the "TitanSert" rapidly reverses out of the predriven insert. "TitanSert" can easily be used with a tapping head mounted on an ordinary drill press; or with automatic air or electric tapping motors when provision is made to keep the tool spindle at right angles to face of casting.

Sizes available: No. 1, Cap. No. 10 to ⅜" I.D.; No. 2, Cap. ⅜" to ½" I.D.

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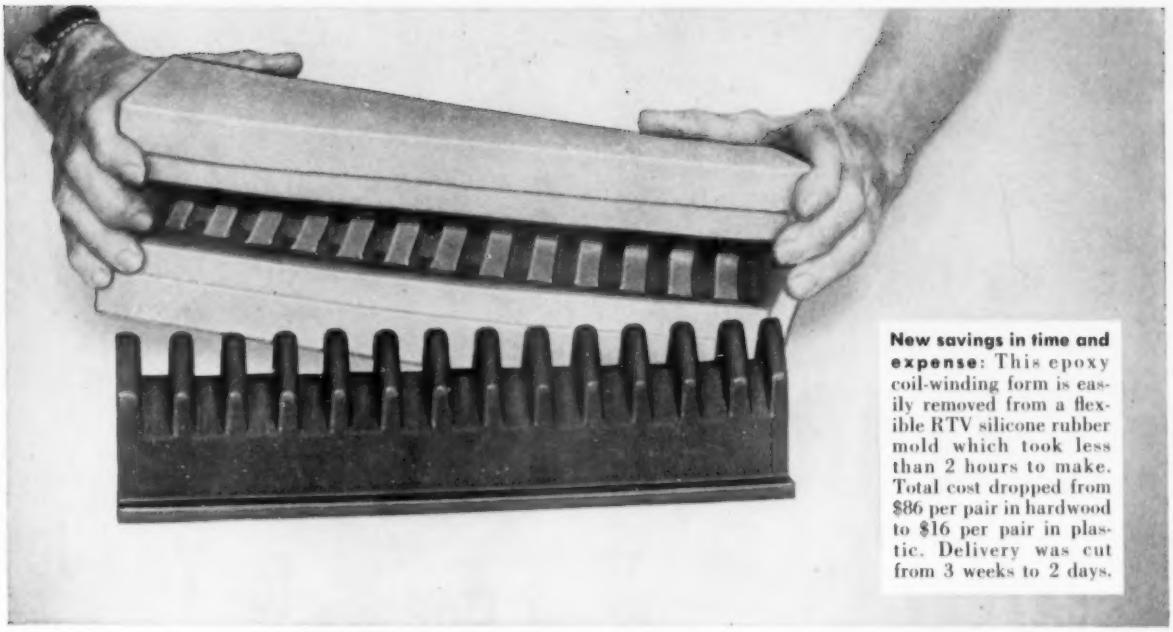
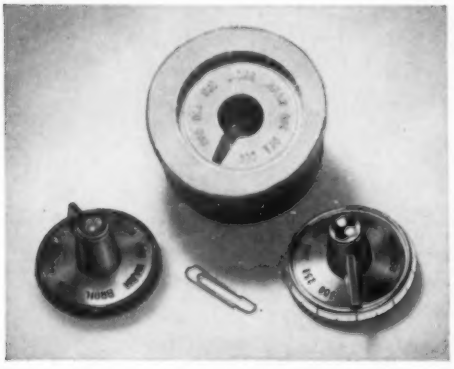


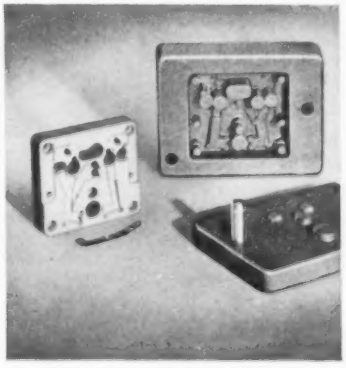
New savings in time and expense: This epoxy coil-winding form is easily removed from a flexible RTV silicone rubber mold which took less than 2 hours to make. Total cost dropped from $86 per pair in hardwood to $16 per pair in plastic. Delivery was cut from 3 weeks to 2 days.

General Electric RTV silicone rubber opens up new fields in tooling and model making

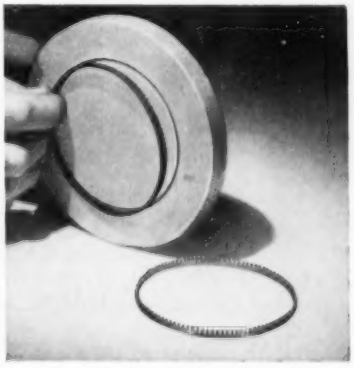
Flexible, needs no parting agent, low shrinkage, duplicates glossy surfaces and fine detail



High-quality prototypes: RTV (room temperature vulcanizing) silicone rubber accurately reproduces surface finish and fine detail. This prototype control knob and other more complicated parts are easily removed from molds without using parting agents. Shrinkage less than 0.2%.



Precision, low-cost tooling: Previously machined from plastic laminate at a cost of $175 each, this fixture is now produced in a two-piece RTV mold at a saving of over $150 per part!



Ideal for casting fragile parts: 20 epoxy duplicates of this fragile actuator ring (.030" thick) were produced in this RTV mold. Even broken machine parts can be reassembled and used as a master to mold new parts.

For application data on RTV silicone rubber write General Electric Company, Silicone Products Dept., Section H1659, Waterford, New York.

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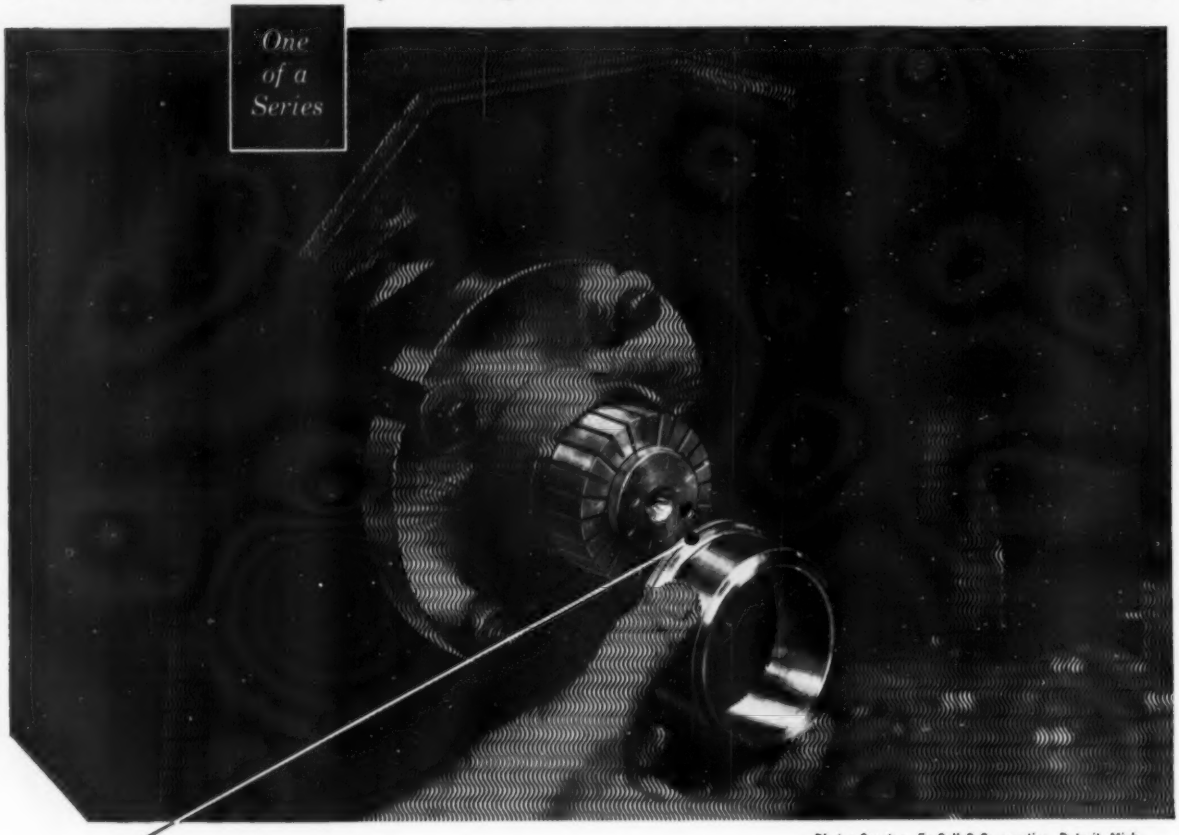
One of a Series



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e. g. stainless steel aircraft sleeves

Tolerances of the highest order are required on aircraft sleeves. And when the material is stainless steel this can lead to production problems.

But Ex-Cell-O Corporation short-circuits their problems by using an Erickson 4½" C Drawbar Expanding Mandrel on an Ex-Cell-O precision boring machine. By using the Erickson mandrel they are able to machine completely the outside diameters, face a shoulder and put chamfers on both the OD and the ID of the exposed end. Production is up, rejects and scrap are down.

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Plagued by tough holding problems? Then let us show you how Erickson Precision Expanding Mandrels speed production and slash costs of machining, grinding, assembling or inspection. Write for your free copy of Catalog K today.

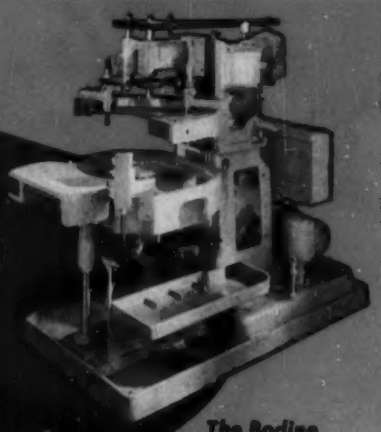
Bodine case history no. 50

whether you figure in

miles · millions · assemblies · tonnage

RUGGED Bodines

have set impressive records



The Bodine Basic Machine

for example:

142 miles

of drilled and tapped holes

The Paine Company is using a Bodine 42-30 to drill and tap anchor inserts (1018 free machining steel). This machine has been in service for 12 years averaging 1500 to 1700 pieces per hour; 1,500,000 per year . . . about 142 miles of drilled and tapped holes.

for example:

36 million

parts in 4 years

United Carr Fastener uses a 48-30 Bodine to tap 5/16-18 holes in 1020 steel dowels. For 4 years this machine has been running at 3600 pieces per hour . . . has produced over 36 million parts.

for example:

9 million

assemblies

Minneapolis-Honeywell uses a Bodine 42-30 for a combination of 10 operations on thermostat wall plates . . . cut off and insert 2 brass terminals — tap (5) #4-40 N.C. holes — insert 2 screws, check and eject. The machine has been running *continuously* for 4 years, completing an average of 35,000 pieces per week . . . close to 9,000,000 assemblies.

for example:

37 tons

of metal removed in 5 years

Elastic Stop Nut Corporation of America uses this Bodine 48-20 to drill, counterbore and tap 10-32 nuts. Five years continuous operation averaging 2500 pieces per hour has produced over 25,000,000 nuts . . . removed an estimated 37 tons of metal in the process.

NO MAJOR OVERHAUL . . .

The Bodine Basic Machines in these case histories have had NO MAJOR OVERHAULS. They are all running day in and day out right now. They are typical of the ENDURANCE, and LONG TROUBLE-FREE service every Bodine owner can expect in machines that are rugged, versatile and capable of multiple tooling and rapid changeover. Send us samples or prints for production analysis . . . without obligation. Write Dept. TE-6

THE **Bodine** CORPORATION

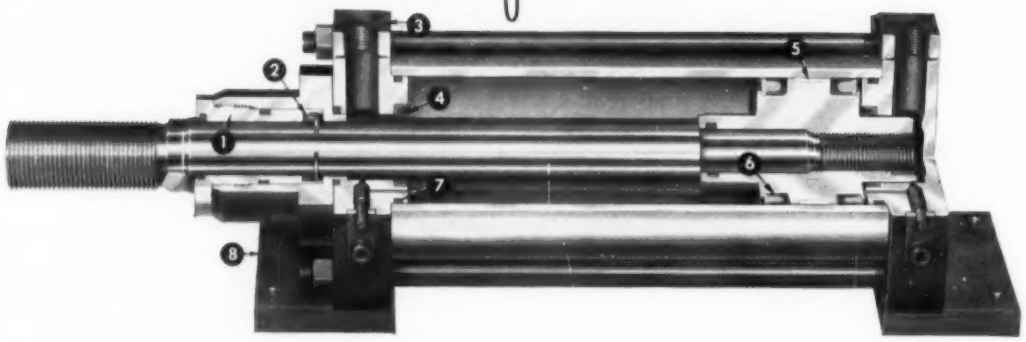
BRIDGEPORT 5 CONNECTICUT

AUTOMATIC DIAL TYPE DRILLING, MILLING, TAPPING, AND SCREW INSERTING MACHINES

28D59

Announcing Valvair®

Check these Valvair features...



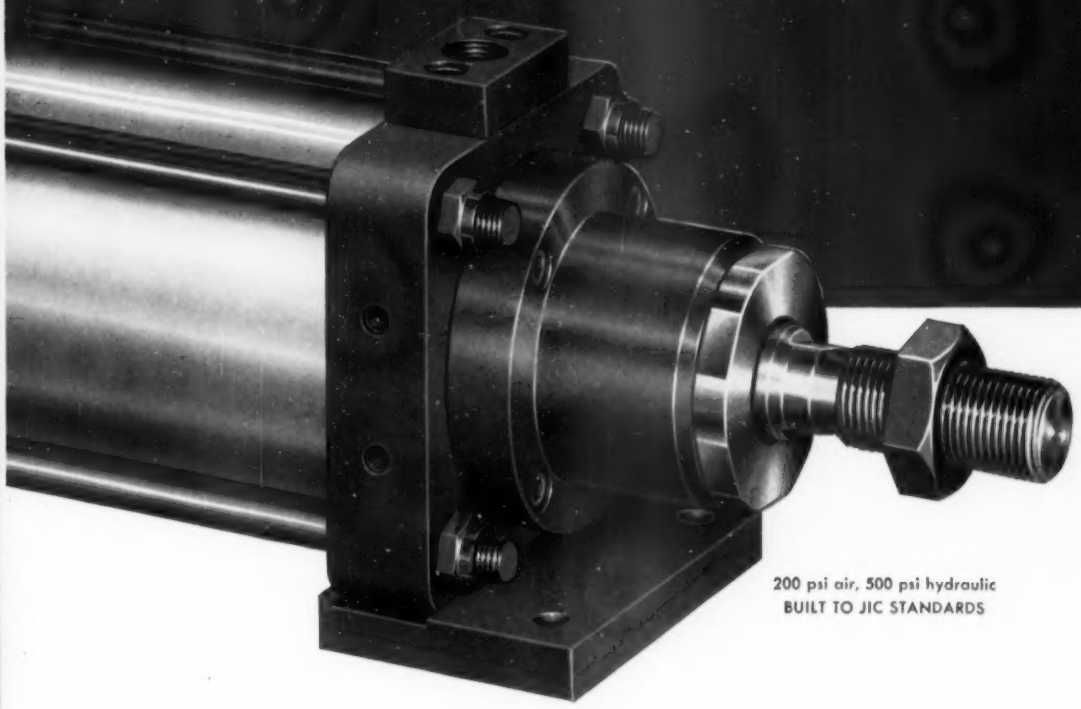
1. **EXTRA-LONG NOSE GUIDE** provides maximum bearing area for piston rod . . . assures peak resistance to side-loading deflection of rod and piston.
2. **CARTRIDGE SEAL** assembly is designed for quick on-the-machine servicing . . . can be replaced without any disassembly of the cylinder.
3. **REMOVABLE PORT ADAPTERS** allow fast exchange of complete cylinder assemblies for bench servicing . . . time consuming piping operations are eliminated.
4. **SELF-ALIGNING CUSHION SEALS** assure uniform cushioning throughout cylinder life . . . unique one-way seal eliminates need for cushion ball check.
5. **TEFLON* WEAR STRIP** on piston prevents metal-to-metal contact between piston and bore . . . scuffing or scoring of bore surface cannot occur.
6. **NYLON-BACKED PISTON CUPS** for air service, or Teflon-backed O-rings for hydraulic applications, provide positive, bubble-tight sealing throughout the cylinder's operating pressure range . . . keeps break-loose pressures low.
7. **POSITIVE BARREL SEAL,** with full-width metal-to-metal contact between barrel and heads maintains leak-free sealing . . . holds dimensional stability under maximum stress.
8. **RE-USABLE MOUNTS,** with precision-fit load bearing slots, handle heaviest operating loads with ample safety factor . . . are easily changed for modification or re-use of cylinder.

*Trade name for duPont tetrafluoroethylene resin

8029

VALVAIR AIR & HYDRAULIC CYLINDERS • SPEED KING CONTROL VALVES AND MANIFOLDS • PLUG-IN CONTROL VALVES AND MANIFOLDS

HEAVY-DUTY AIR AND HYDRAULIC CYLINDERS



200 psi air, 500 psi hydraulic
BUILT TO JIC STANDARDS

Here is a cylinder on which you can stake your reputation . . . built by Valvair, makers of famous SPEED KING control valves. With design features based on years of application engineering experience in high-production manufacturing operations, Valvair's new heavy-duty air and hydraulic cylinder offers performance, durability and ease of maintenance. Construction and component materials have been coordinated to assure efficient, trouble-free operation, plus longest service life with minimum machine downtime.

For detailed information, write for Bulletin VC-800, Address Dept. TE-659, Valvair Corporation, Akron 11, Ohio.

Built to JIC Standards and offering a full range of bore and rod sizes, interchangeable mounting styles, stroke lengths and cushioning options, you'll find Valvair heavy-duty cylinders ideal for your non-rotating cylinder applications. Take advantage of one-source responsibility for all your control system needs . . . cylinders, valves, manifolds, filters, regulators and lubricators . . . call in your nearby Valvair field engineer today.

Offices in principal cities.

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DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION

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SOUTHWEST

"Monoball"

SELF-ALIGNING BEARINGS

CHARACTERISTICS

	ANALYSIS	RECOMMENDED USE
1	Stainless Steel Ball and Race	For types operating under high temperature (800-1200 degrees F.).
2	Chrome Alloy Steel Ball and Race	For types operating under high radial ultimate loads (3000-893,000 lbs.).
3	Bronze Race and Chrome Steel Ball	For types operating under normal loads with minimum friction requirements.

Thousands in use. Backed by years of service life. Wide variety of Plain Types in bore sizes 3/16" to 6" Dia. Rod end types in similar size range with externally or internally threaded shanks. Our Engineers welcome an opportunity of studying individual requirements and prescribing a type or types which will serve under your demanding conditions. Southwest can design special types to fit individual specifications. As a result of thorough study of different operating conditions, various steel alloys have been used to meet specific needs. Write for Engineering Manual No. 551. Address Dept. TE-59.

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. . . on your Automatic or Turret Lathe with the amazing CHATWIN polygon tool box

. . . save time

. . . save money

. . . speed production

With this Tool Box you can turn hexagonal, octagonal and other irregular contours from round stock, drilled and finished in one operation. Produce mating internal and external shaped parts. Write today for complete details.

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DETROIT 15, MICHIGAN

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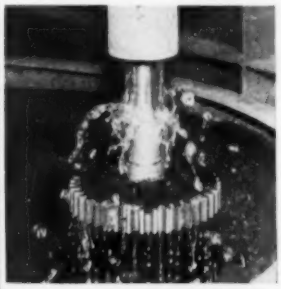
Here's how ALMCO's New Spindle Finishing Process gives precision finishing of complex components...

1 Operator air-chucks part to be finished to spindle after having just released the finished part.

2 Part is lowered into high velocity stream of abrasive media. Spindle rotates while in stream.



3 Index head carries spindle thru tub of abrasive media until it again reaches operator's station. Water rinses media away.

4 Result: fast and even action! In most cases, 0.005 to 0.015-in. radii can be generated on hardened gear teeth in 2-4 mins.

. . . and on a continuous production line basis!

The ALMCO Spindle Finishing Process now makes possible precision finishing of complex, high-quality components such as gears, bearing cages, spline shafts, pump rotors, jet blades, etc. . . .

- *at production rates heretofore not possible . . .*
- *on a continuous production line basis . . .*
- *and with all surfaces receiving the same controlled amount of precision finishing!*

Here's how it works. Large parts or clusters of smaller parts are chucked directly to the spindles from a single operator's work station. Spindles lower the parts into a high velocity stream of abrasive media contained in a tub that rotates at a controlled speed of from 275 to 600 sfpm at the spindle center line. Spindles themselves also rotate at 13 rpm while in the abrasive stream, while the indexing head slowly carries all spindles in a 1 to 9 minute trip around the tub. Operator merely removes and replaces parts on spindle chucks as they appear before him. Models are available with automatic or manual indexing, 2 to 16 spindles, tub diameters of 48" to 90", and drives of from 5 to 30 hp.

For Full Story on ALMCO Spindle Systems and on free processing of sample parts, write for ALMCO Album of New Products!

ANOTHER REPORT FROM THE ALMCO ALBUM OF NEW PRODUCTS

ALMCO

QUEEN PRODUCTS DIVISION

King-Seeley Corporation

186 E. Main Street

Albert Lea, Minnesota

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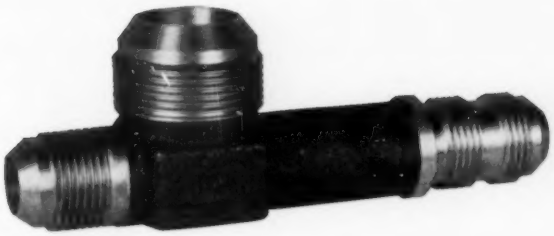
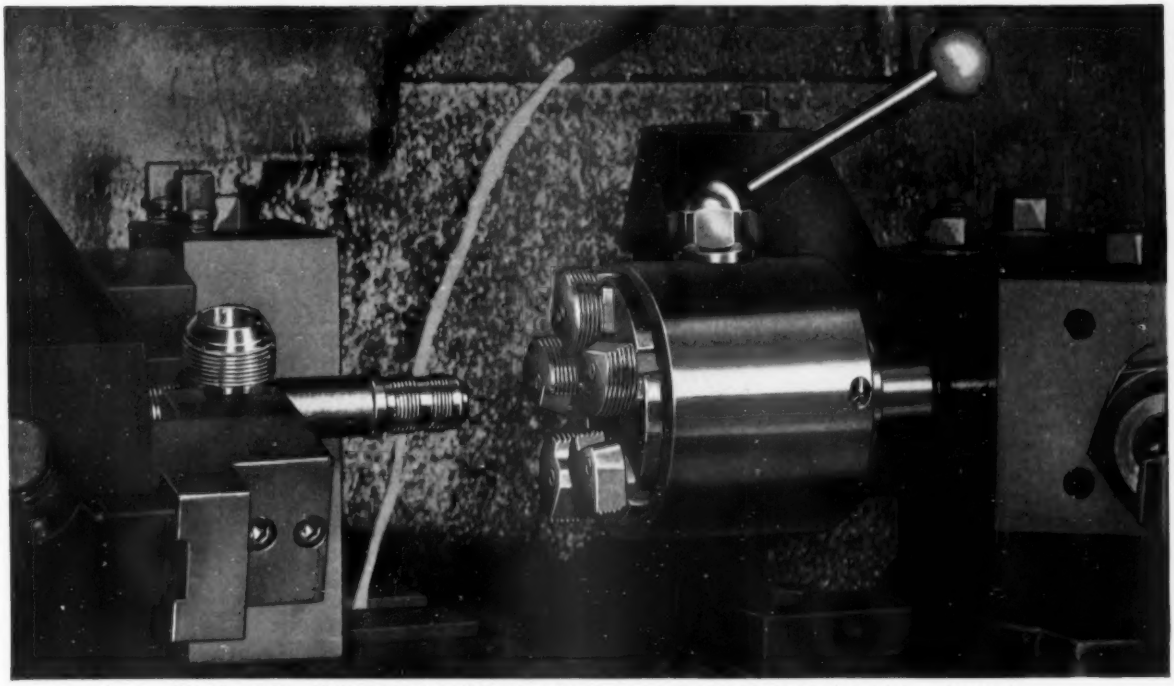
When Threading Specs Read A.Q.R....*



Parker standardizes on 5 Chaser Vers-O-Tools



1⅛—12 and 1⅛—12 threads cut on this 316 stainless steel forging. A 30 microinch finish is maintained.

*"Additional Quality Required" are by-words for this leading manufacturer of precision fittings. The rigid specifications for critical missile components produced in their Cleveland, Ohio plant demand *better than aircraft quality*. "That's why we use Namco Vers-O-Tools almost exclusively," says D. S. Manning, Manager, Parker Fittings & Hose Division, Parker-Hannifin Corporation. "These automatic 5 chaser die-heads eliminate lead error, taper and grooves on the thread flank . . . with overall thread quality at least 50% better than 4 chaser heads. The result is precision fittings with true seating surfaces and a perfect gauge fit."

Prove these facts for yourself: more pieces per grind; precision threading of parts with undercuts, flats, slots; unsurpassed economies in chaser grinding and precise relocation of chasers without readjustment . . . *and* a complete range of sizes. Namco 5 chaser Vers-O-Tools are only a part of a complete line of threading tools designed to provide the tolerances and finish required for *your* toughest jobs. Write for complete information.

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Achieve efficient, automatic production, and produce more all along the line, by integrating equipment designed and built by AUTOMATION for automation.

For example, vibratory parts feeders perform more efficiently on an engineered base permitting maximum power transmission. Either the side delivery or the elevating conveyor supply hoppers (with automatic paddle type relay switch to regulate delivery) hold large quantities of parts and are real labor savers. These are just a few advantages that make automation work and pay for itself.

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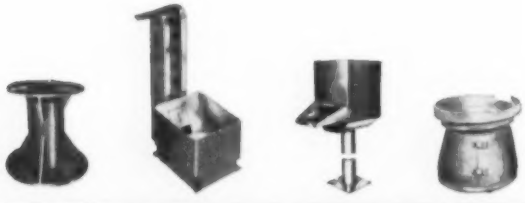
PEECO & VFC DIVISIONS ... *TWO GREAT NAMES IN PARTS FEEDING*



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CARR-LANE JIG *and* FIXTURE *Components* ... make the biggest **HITS**

... and why not ... they're precision made to exacting tolerances ... they're heat treated and rust proofed ... they sell for a fraction of the cost of producing them in your own shop. See Our Catalog for the thousands of items in **STOCK!!!**

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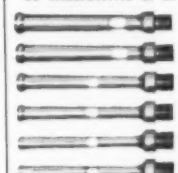
Mahr — 50 Millionths Reading SELF-CENTERING BORE GAGES

Check bores for size, out-of-round and taper in any spot and to any depth within range of instrument to an absolutely reliable accuracy of 50 MILLIONTHS of an inch

THIS HIGH PRECISION INSTRUMENT IS AN INEXPENSIVE, ACCURATE AND DEPENDABLE INTERNAL COMPARATOR



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Complete in Hardwood Case
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OTHER SIZES UP TO 10"

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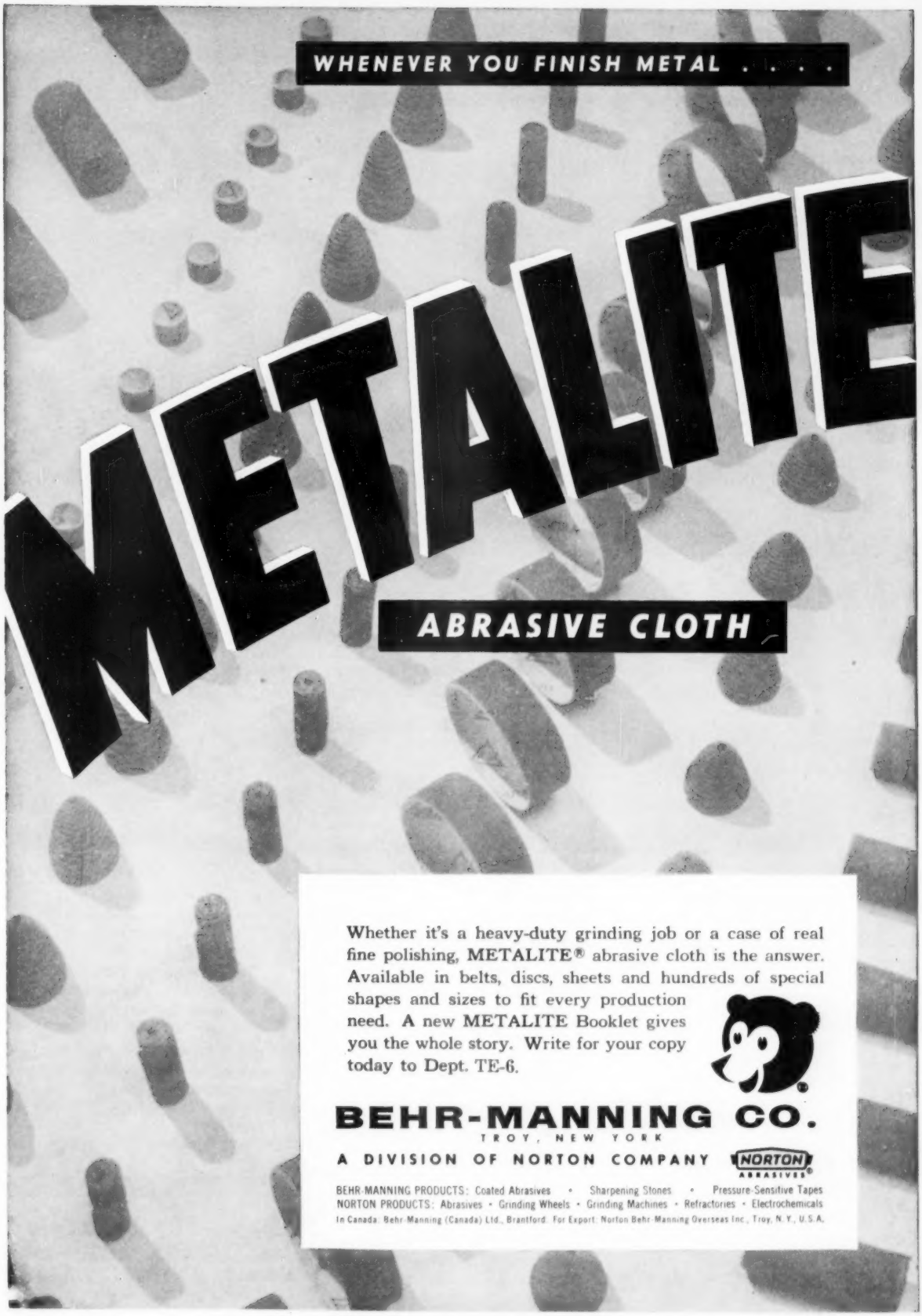

Whether it's a heavy-duty grinding job or a case of real fine polishing, METALITE® abrasive cloth is the answer. Available in belts, discs, sheets and hundreds of special shapes and sizes to fit every production need. A new METALITE Booklet gives you the whole story. Write for your copy today to Dept. TE-6.

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BEHR-MANNING PRODUCTS: Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes
NORTON PRODUCTS: Abrasives • Grinding Wheels • Grinding Machines • Refractories • Electrochemicals
In Canada: Behr-Manning (Canada) Ltd., Brantford. For Export: Norton Behr-Manning Overseas Inc., Troy, N.Y., U.S.A.

Ready to produce and produce and produce

SPEEDOMETER FRAME

WINDSHIELD WIPER HOUSING

These two machines are shown on our assembly floor ready to ship. One is a simple double-end machine with no indexing, the other a large center-column machine with indexing.

Both machines operate on die castings at high production rates. Both have power clamping and unclamping. Each operator removes a finished part, puts a new one in the fixture and presses buttons to clamp it.

The customers approved test runs here on our assembly floor. They continue to get good production because of good basic design and rugged, accurate construction.

Speedometer Frame 600 parts per hour is the gross production on the double-end machine (left) The left unit threads a stem with a self-opening die head while the right unit taps two holes. Another Kingsbury (not shown) operates on 11 holes in the same part.

Windshield Wiper Housing 460 parts per hour is the gross production on the big 13-spindle machine. A 43-inch index table holds seven work fixtures. The face to be milled is on top.

The first unit at the man's left mills the face at 3500 rpm. It is 30° right of the radial centerline through the station. For the holes in the center sketch there are four horizontal units, each 60° left of the radial centerlines.

Four vertical units operate on holes in the right sketch A combination tool machines the .500 hole and 2.884 bore concentric within .003 T.I.R

Special features include —

— Filtered coolant for all tools and gun reaming of two holes for a high finish.

— Oil mist lubrication for the multi-spindle auxiliary heads.

— Lights that identify any unit that fails to complete its cycle.

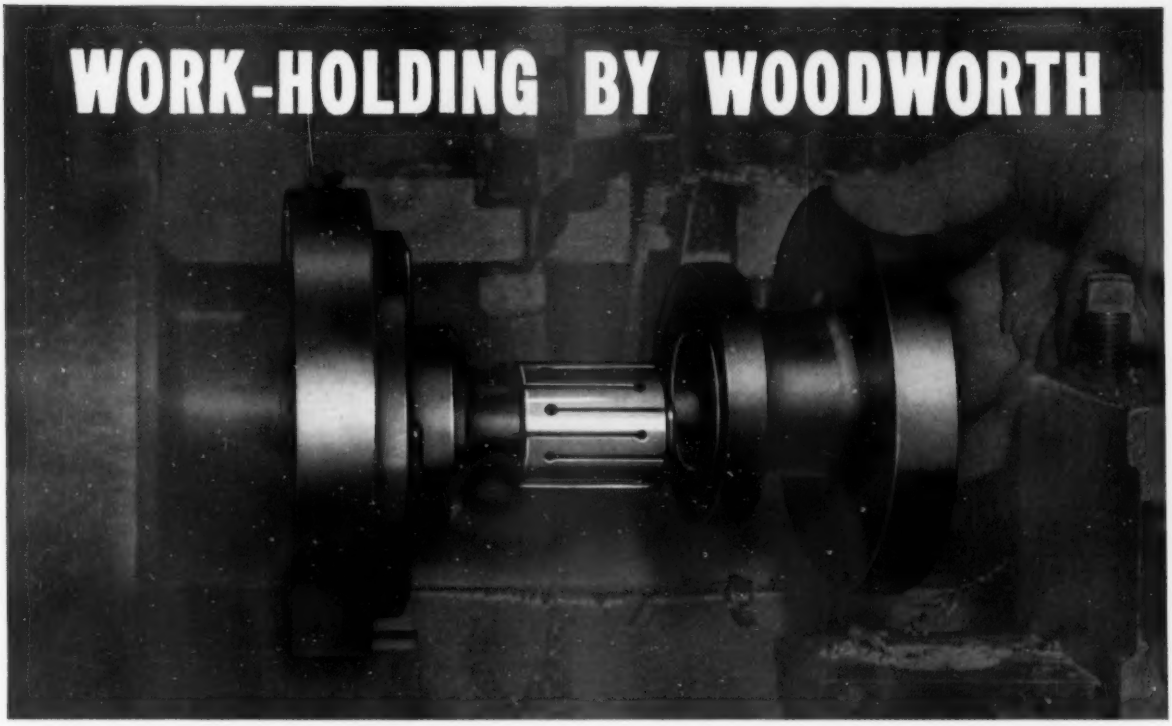
Little downtime, few rejects Our customers tell us that their Kingsburys run month after month without trouble. A Kingsbury can do the same for you. Kingsbury Machine Tool Corp., Keene, New Hampshire.

KINGSBURY

MULTI-UNIT AUTOMATICS

USE READER SERVICE CARD; INDICATE A-6-236

WORK-HOLDING BY WOODWORTH



WOODWORTH ARBOR SOLVES TOUGH PROBLEM FOR DANA PLANT SUPERINTENDENT

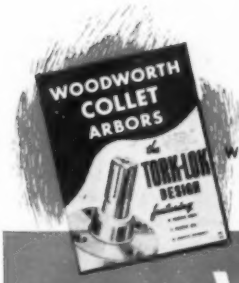
CHARLES VAUGHN

- **CHARLES VAUGHN,** *Dana Plant Superintendent, reports: "Since specifying Woodworth "TORK-LOK" Arbors, our arbor replacement has decreased and production has increased. As a result, we are now able to assure our customers better service and the benefit of cost reduction since we have eliminated breakdowns and the loss of time due to arbor failures".*

- **The WOODWORTH "TORK-LOK" COLLET ARBOR** is the answer to the work holding problem in intermediate transmission gears manufactured by the Toledo Division of Dana Corporation, Toledo, Ohio.

  In their green turning operation on a Lodge & Shipley 2A Duomatic Lathe, four tools, cutting simultaneously, remove 1/8" from the back face, 1/32" from the front face, 1/16" from the hub face and 1/8" on the finish turned O.D. with a 1/4" radius on both corners, without chatter or slippage and with no tail stock center support. A .005" tolerance is held on the finish diameter and .002" on the overall length.

WOODWORTH'S "TORK-LOK" DESIGN features POSITIVE DRIVE . . . POSITIVE SEAL . . . POSITIVE ACCURACY



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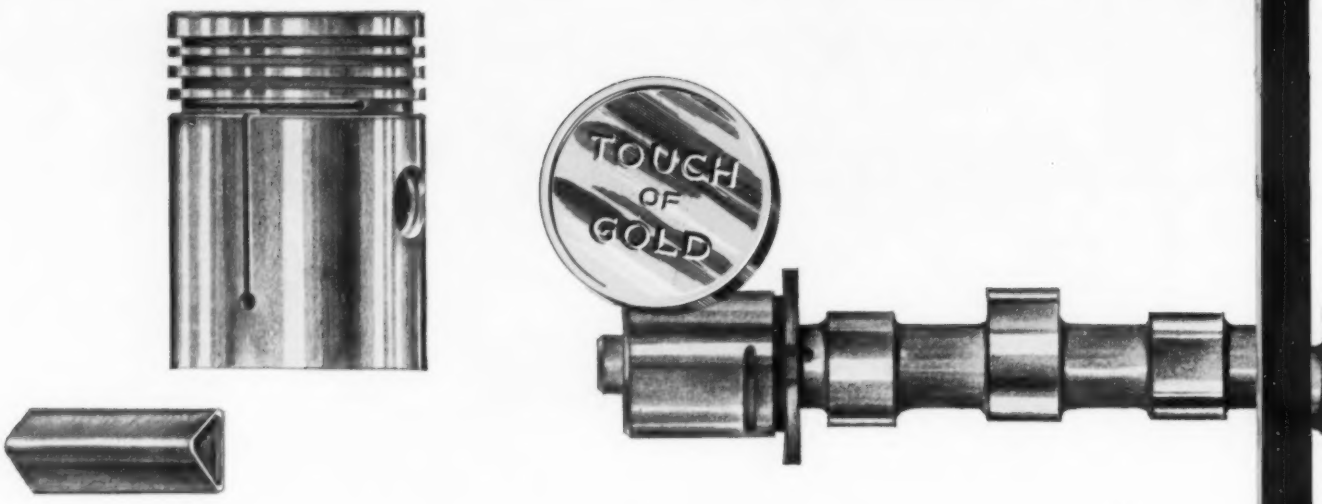
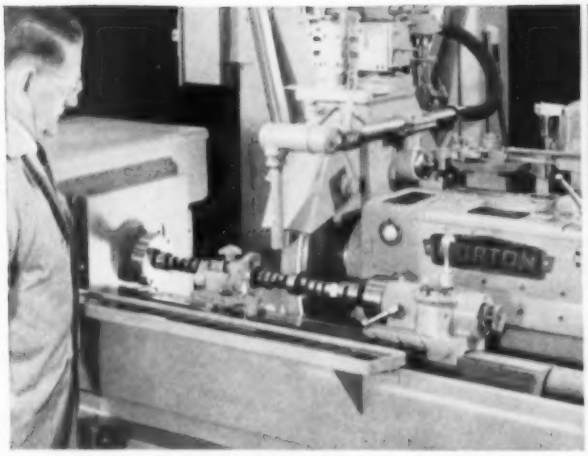
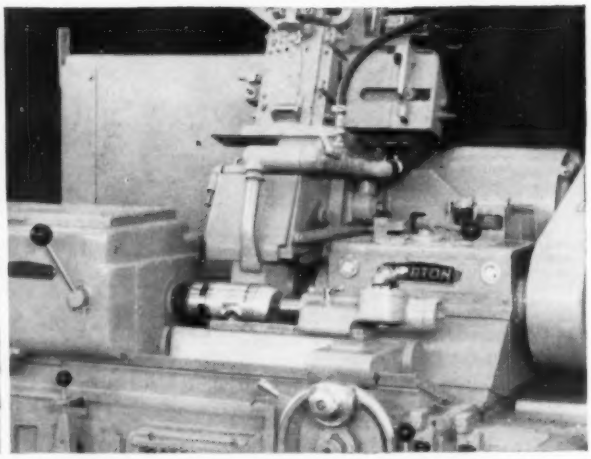


If you grind
special shapes . . . like these

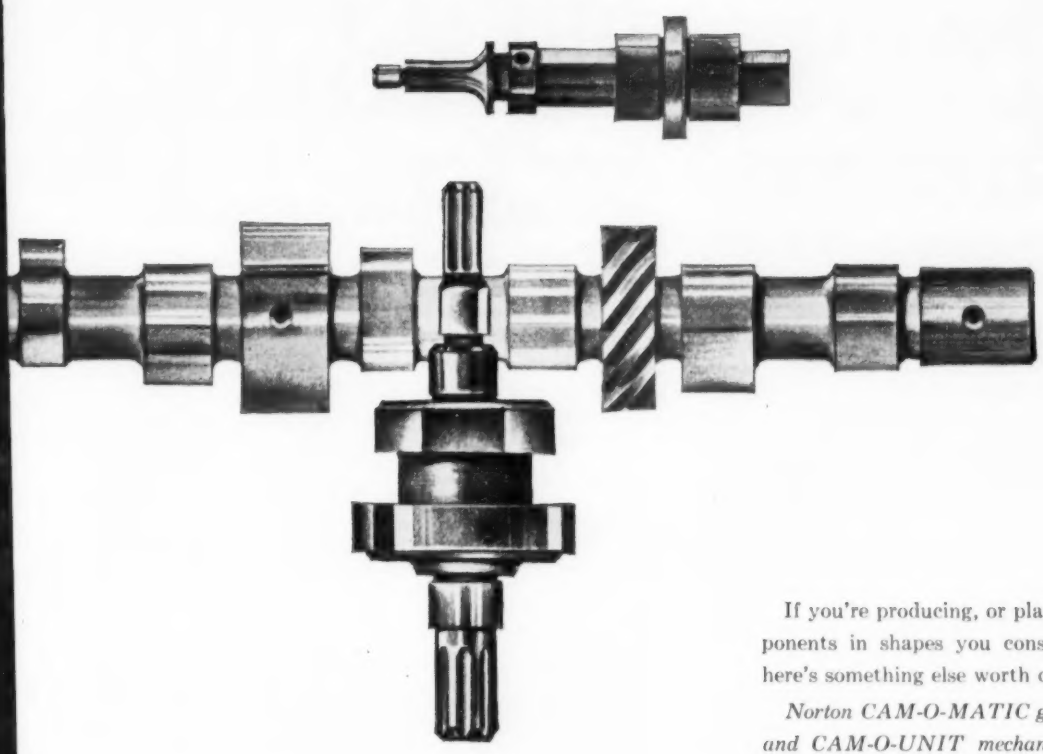
Check the special advantages of Norton grinders . . .



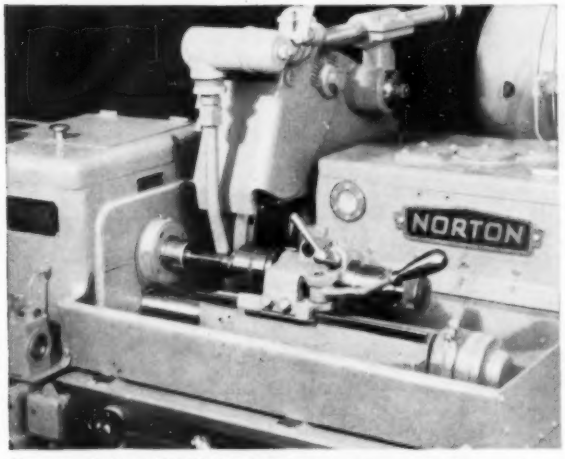
With a Norton No. 3 CAM-O-MATIC® Grinder, you grind all cams and the eccentric on an automotive-type camshaft automatically, in one handling. Automatic wheel truing and a patented device for grinding cam tapers in one or both directions are among the features that improve contour, finish and production rate.



A Norton 6″ x 8″ Semiautomatic Piston Grinder adds extra speed and economy to your grinding of elliptical pistons. Mechanism arrangements enable you to grind complex ovality into the skirt of a piston, as shown, or to produce standard ovality or different amounts of relief over a wide range.



. . . like these



Norton CAM-O-UNIT* Mechanisms, made in varying work capacities, are particularly valuable for extending the proved advantages of Norton CTU cylindrical grinders to the grinding of cams, elliptical pistons and many other forms. The CAM-O-UNIT mechanism shown is attached to a 6" CTU to grind the three faces of a carbide tool bit.

If you're producing, or planning to produce, components in shapes you consider difficult to grind, here's something else worth considering.

Norton CAM-O-MATIC grinders, piston grinders and CAM-O-UNIT mechanisms are engineered to handle a wide range of cam and shape grinding . . . including endless variations of square, triangular, oval and many-sided forms . . . and to provide the exact forms and tolerances you need with fast, trouble-free performance that will lower your operating costs.

Shapes you can produce on this special grinding equipment include not only arcs but curves and tangent flats in combination. Your Norton Man, a trained grinding engineer, will be glad to give you expert help in selecting and operating grinding equipment that will bring you top-quality, low-cost results on the toughest jobs. NORTON Company, Machine Division, Worcester 6, Mass. District Offices: Worcester, Hartford, Cleveland, Chicago, Detroit. *In Canada:* J. H. Ryder Machinery Co., Limited, Toronto 5.

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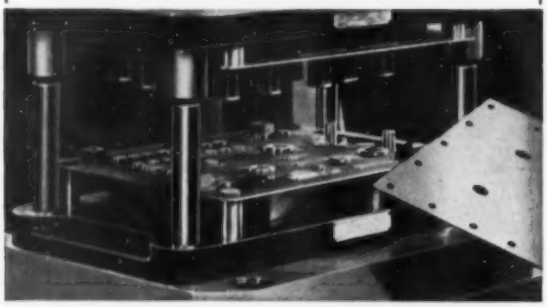
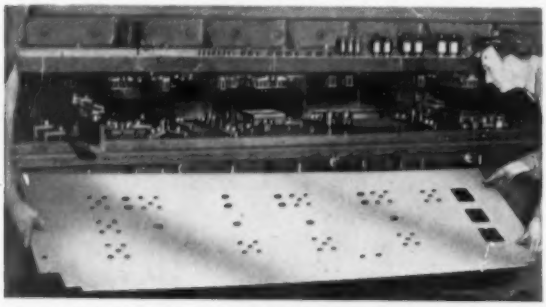
OVER 2700 PLANTS
are saving money with
WHISTLER DIES



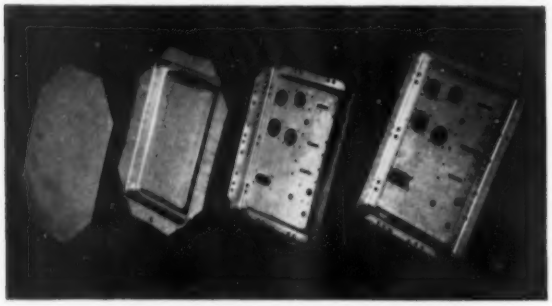
MAGNETIC PERFORATING DIES

All parts reusable and interchangeable. Punches and dies stocked in .001" increments from .100" thru .500" dia. Larger sizes available.



ADJUSTABLE PERFORATING DIES

All parts reusable and interchangeable. Punches and dies stocked in .001" increments from .100" thru .500" dia. Larger sizes available.



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Mail the following: ☐ Magna-Die Catalog ☐ Adjustable Die Catalog
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COMPANY _____

STREET _____

CITY _____ ZONE _____ STATE _____

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DIE CUSHIONS

by Dayton Rogers

FOR ALL PUNCH PRESSES

to assure accurate working pressure on all dies

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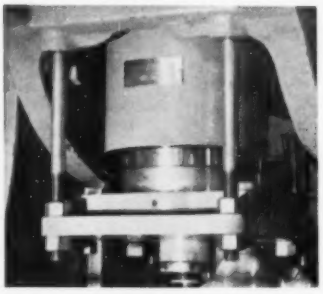

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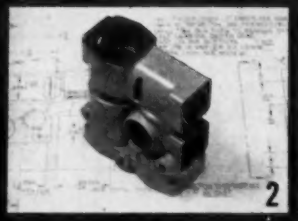
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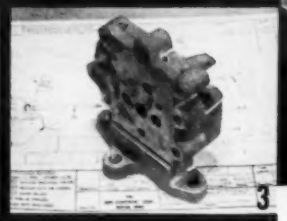
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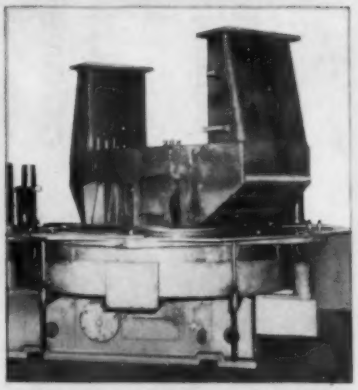

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BATH *Tap'n Gage* TIMES

A series of technical discussions that will be helpful in getting better results from tapping and gaging operations

Vol. 1 No. 6

Subject: Tapping the Difficult to Machine Materials:

The "missile age" has brought about the development of new materials designed to withstand the extreme stress, heat and strength problems inherent in jet engines, high speed aircraft, missiles and similar military hardware. These materials are classed as "difficult to machine" in comparison with the common types of steels, irons and light alloys.

General Tapping Data

It is essential that all of the rules for good machining practice and tapping procedure be followed. Initial design specifications for threaded holes should favor the tap wherever possible. A copious supply of coolant must be provided and the coolant temperature should be maintained as low as possible. Tapping speeds should be reduced considerably in comparison with ordinary practice.

Titanium and Titanium Alloys

The basic characteristics of this material are low volume specific heat and low thermal conductivity. These thermal properties are best combatted by reducing the rate of heat generation. In tapping, heat generating friction is minimized by eccentric relief in the threads, additional chamfer relief, interrupted threads and increased back taper.

Hand taps with the standard number of flutes and chamfers of 4 to 8 threads have proved satisfactory. Bottoming holes may require series or sets of taps. Spiral pointed taps are satisfactory for through holes not exceeding 2 diameters.

Abrasive wear and galling can be reduced by case surface and oxide treatments. Tapping speeds vary from 40 SFM for the softer grades down to 10 SFM or less for the toughest grades. A maximum 65% of thread height is suggested and cutting fluid should be an activated sulpho-chlorinated oil. If standard taps are not satisfactory, Bath Type "R" or "RR" are recommended.

High Tensile Steels (Super-Strength Steels)

The basic characteristic of these materials is the hardness after heat treating which ranges up to 58 Rockwell C. Tapping difficulties vary with the analyses even though Rockwell readings may be the same. Tap recommendations for these materials must include careful consideration of cut per tooth. Taps with four flutes and 6 to 8 threads chamfer have given best results. A cutting face angle which is approximately radial (0° rake) should be used. Tapping speeds should not exceed 10 SFM and cutting fluid should be activated sulpho-chlorinated oil, generously applied. If standard taps are not satisfactory, the use of special high Rockwell high speed steels such as Bath "N Steel", will be required.

High Temperature Alloys (Superalloys)

The basic characteristic of these materials is their tendency to work harden. Hardness and resistance to cutting varies with each alloy group. Cutting speeds and tap design must be tailored to the particular alloy. A cutting face hook of from 0° to 10° should be used. The harder the material the lower the hook. Chamfers should be from 3 to 5 threads and thread relief should be used to reduce work hardening due to rubbing. Tapping speeds must be kept low and in extreme cases are in the 5 to 10 SFM range. Thread height should be kept as low as possible and activated sulpho-chlorinated cutting oil is recommended. If standard tap materials are not satisfactory, Bath "N Steel" will be required.

Stainless Steel

Free machining grades are not much more difficult to tap than ordinary mild steels. The difficult grades require taps designed with free cutting characteristics. Thread relief, interrupted threads, hook angles of 8° to 12°, increased back taper and certain surface treatments help to reduce friction. Spiral pointed taps give good results where applicable. Tapping speeds are in the range 10 to 40 SFM and activated sulphorized and chlorinated oils are the most generally used coolant. If standard taps are not satisfactory Bath Type "R" should be specified.

For further information on this subject, fill out and mail attached coupon with 25¢ for technical brochure "Milling, drilling and tapping the difficult to machine materials" — published by the Metal Cutting Tool Institute.

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June 1959

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LOOKING AHEAD

By T. W. Black
Senior Associate Editor

Wage inflation, according to Ford vice president Ben D. Mills, will be the number one economic problem for years to come. He points out that the inflationary approach to economic growth is a dangerous one. Looking ahead, he sounds an optimistic note:

"If we succeed in solving this problem of inflation and in meeting the challenge of technical progress, we can confidently expect in the mid-1960's to unleash a solidly based boom unlike anything we have ever known in our history."

Although the contract tool and die industry has lagged behind other manufacturing in recovery from the recession, Jack Kleinoder, president of the National Tool & Die Manufacturers Association, feels that the capacity of his industry is none too big for the production requirements of the decade ahead:

"Both giant industries and the small tool, die and machine shops will again have to expand their capacity if they are to provide the goods and services needed for our growing country," he says.

Part of this expansion will come as the result of replacing older machines. A new replacement formula analyzes replacement projects in terms of avoidable costs that would be incurred by postponing replacement decisions for one, five or ten years. Copies of a booklet describing the formula are available from Jones & Lamson Machine Co., Springfield, Vt.

Once new machines are installed, their full productive capacity should be utilized. A survey by Kennametal Inc. discloses that "many production men today are running $50,000 machines to baby $10 cutting tools." Cutting at higher speeds shortens tool life but in increased machine output can result in savings of $14 for every additional dollar of tool costs.

Indexable, throwaway carbide inserts contribute substantially to increased machine output. Many successful applications are described in an article to appear in the June 15 issue of this magazine, which will also contain the long-awaited Suppliers Directory.

Skilled machinists, toolmakers, die sinkers and other craftsmen will be in short supply, according to a New York State Department of Labor study. At present, plants in that state are training only 30 to 40 percent of the skilled craftsmen that will be needed by expanding industry during the next six years. Unless positive action is taken by industry to increase plant training programs, the shortage will become critical. Similar shortages are faced in other states.

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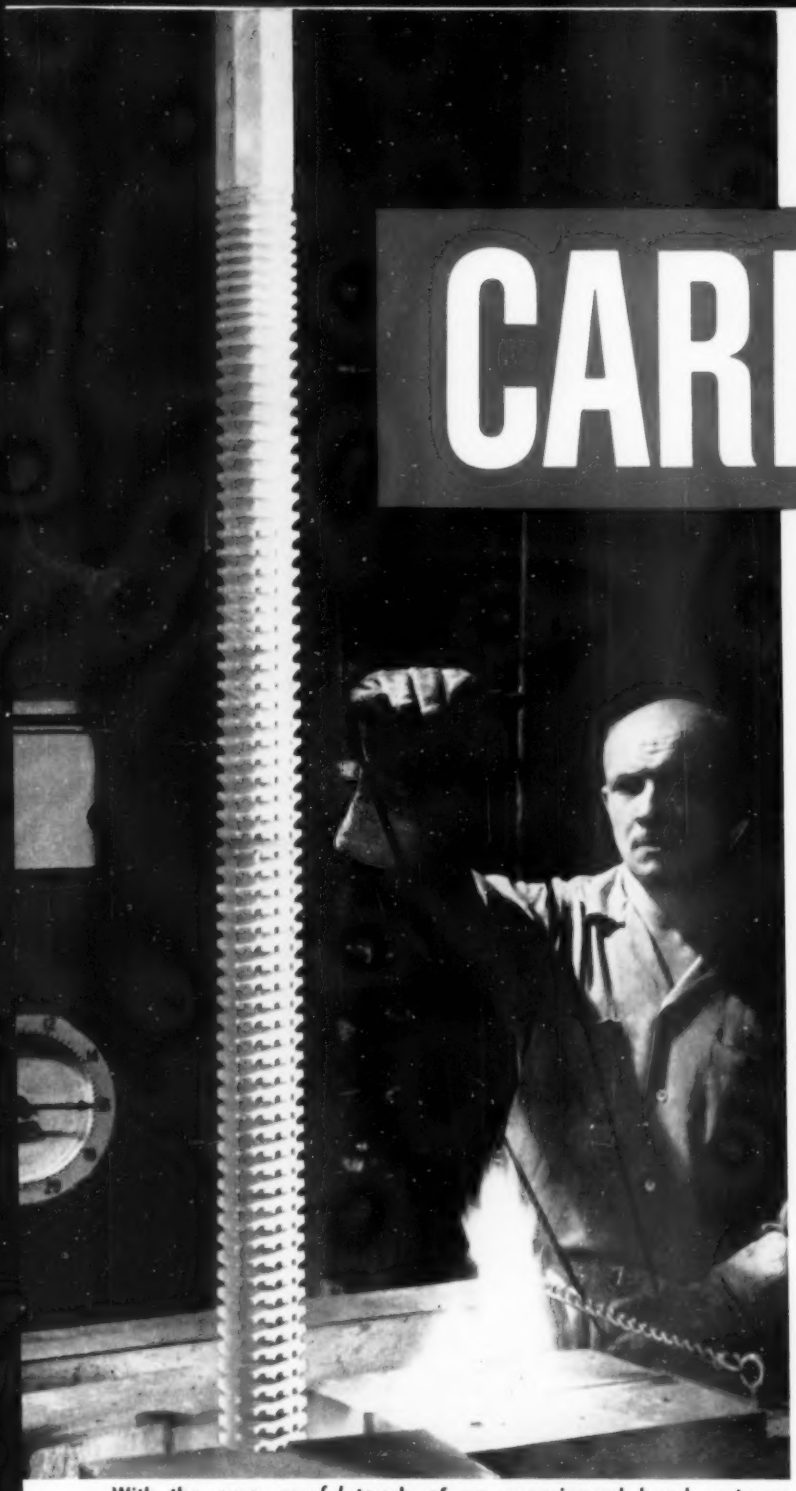

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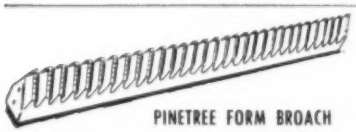

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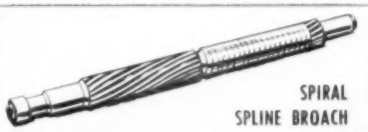

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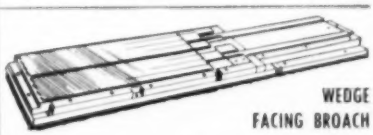

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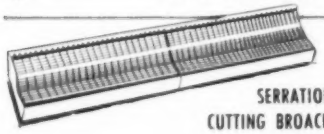

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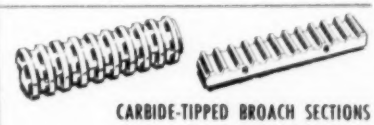

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